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FLORAE MALESIANAE PRAECURSORES LVI. ANACARDIACEAE

DING HOU
Rijksherbarium, Leiden, Netherlands

CONTENTS

SUMMARY

Ten new species have been proposed in the following genera: *Gluta* (5), *Swintonia* (1), and *Melanochyla* (4).

Seventeen new combinations have been made in the following genera: *Gluta* (11), *Melanochyla* (3), *Semecarpus* (1), *Drimycarpus* (1), and *Nothopegia* (1).

Abaxial epidermal papillae of leaves occur in seven genera. Their patterns (as observed under low magnification), which can be used sometimes as diagnostic characters, are grouped and representative species listed.

The genus *Drimycarpus* is newly recorded for the flora of Malesia.

The generic delimitation of *Gluta* and *Melanorrhoea* has been reviewed, and reasons are given why the latter is merged with the former.

Coalescent cotyledons, recorded until now only for *Gluta renghas*, have been found occurring also in other species of the genus *Gluta*.

An Indian species described as *Ficus (Moraceae)*, suggested to be an Anacardiaceous plant, belongs to *Nothopegia* (extra-Malesian genus).
A historical review and typification for the subdivisions of *Mangifera* have been made; two sections of this genus have been accepted and their representatives listed.
Notes are given for various taxa on their taxonomy, nomenclature, typification, distribution, gross morphological characters, etc., and for dubious and excluded species.

INTRODUCTION

In Malesia, the *Anacardiaceae* comprise mainly trees of small to medium or big size. Plants of this family are rather easy to recognize in the field especially by the presence of resinous sap quickly turning black when exposed to the air; with some experience they can be recognized as to belong to certain genera without much difficulty. Through the interests and efforts of especially the local Forest Departments large collections, also including many sterile specimens, have been accumulated.

In the course of the revision of this family for the Flora Malesiana, based chiefly on herbarium material, I have been confronted with a number of problems, especially concerning species delimitation, caused by the incomplete material, the highly variable characters of leaves and fruits, and my lack of field experience.

A grant from the Netherlands Foundation for the Advancement of Tropical Research (WOTRO), The Hague, enabled me to do field work on this family in the Malay Peninsula and Borneo, for which I feel grateful. An account of this trip was recorded in my stencilled 'Report of a study-trip on *Anacardiaceae* to Malaysia and Singapore in 1966' (23 pp.; 1966). The acquired field knowledge has been of essential value for my work.

The revision of the *Anacardiaceae* in the Flora Malesiana will be published soon. The present precursor consists of new taxa and other items as listed in the contents and summary; part of it can be used as commentary notes to this revision.

Collections examined for the revision will be listed in the 'Identification Lists of Malesian Specimens'.

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I am grateful to Prof. Dr C. G. G. J. van Steenis and Dr W. Vink for critically going through and polishing the manuscript of *Anacardiaceae* for the Flora Malesiana together with this precursor and also for their valuable remarks or suggestions.

I also express my thanks to those who have helped me in the course of this study; many of them have been acknowledged in my Report or in the text.

PAPILLAE OF THE ABAXIAL LEAF EPIDERMIS

The abaxial surfaces of leaves are papillose in many species of *Semecarpus*, *Melanochyla*, *Swintonia*, *Drimycarpus*, *Holigarna* (extra-Malesian), and *Nothopegia* (extra-Malesian), and in one species of *Rhus* (*R. chinensis*). The epidermal papillae are sometimes very distinct

and give the surface a mat-like appearance as seen under a dissecting microscope at low magnification. They can sometimes be used as a diagnostic character on the species level, as has been done by Engler (in DC., Mon. Phan. 4, 1883: 474). Their presence can be especially helpful for identifying sterile collections to narrow down the choice among genera or species.

The characters of papillae, for example, presence or absence, distinctness, arrangement, places of occurrence, etc., are rather variable and should be used with caution or in combination with other features. From the specimens examined, so far, I have not found correlations between these variations and ecology (cf. Baas, Blumea 18, 1970: 383; Jansen & Baas, Blumea 21, 1973: 177; Bongers, Blumea 21, 1973: 386). Field observations and experimental and morphological studies are needed on these points.

The leaves of seedlings of *Semecarpus curtisii* (*van Balgooy 2635*) are distinctly papillose like the leaves on the specimens collected from trees. However, the seedlings of *Swintonia schwenkii* (*Kochummen s.n.* & *FRI 2559*) have leaves also distinctly papillose while the leaves on the specimens obtained from trees are obscurely or indistinctly (or non-)papillose. The seedlings were raised at Leiden from seeds collected in the Malay Peninsula.

In specific descriptions and sometimes also in the keys of the *Anacardiaceae* for the Flora Malesiana, the papilla features have been treated just like other gross morphological characters. At low magnification the leaves with obscure or indistinct papillae can sometimes hardly be distinguished from the non-papillose ones, so such leaves have sometimes been treated indiscriminately as belonging to the same group.

Wilkinson (Leaf anatomy of various *Anacardiaceae* with special reference to the epidermis, 1971: 1—626, with many plates and figs, Ph.D. thesis, Univ. London, not published) studied the papillae of some species of *Semecarpus*, *Melanochyla*, and *Swintonia*. According to her, the appearance of the papillae in these genera is alike, but morphologically the papillae can be divided into two types: 1) 'frilly-striate' and without distinct lobes (her thesis fig. 9 A, D) and: 2) lobed and usually not striate (her thesis fig. 9 B, C). For the microscopical morphology of the papillae, the reader is referred to her thesis.

For reference, the arrangements of epidermal papillae have been conveniently and roughly grouped and representatives are listed. Some stereoscan photomicrographs of the abaxial surfaces, by courtesy of the Geological Institute, University of Leiden, have been selected for publication here to show various papilla-patterns which can be observed at low magnification.

A. Papillae absent or indistinct. Stomata sometimes visible.
   Drimycarpus spp. *(p.p.)*.
   Melanochyla: angustifolia, auriculata, bracteata, minutiflora, nitida.
   Nothopegia castaneaefolia (p.p.).
   Semecarpus: lamii, longifolius (p.p.), papuanus (p.p.).
   Swintonia: floribunda, robinsonii, schwenkii (p.p.), spicifera (p.p.).

B. Papillae present, usually distinct, apart or compact.
   Stomata usually completely hidden by papillae.
   B1. Areoles and veins surrounding them papillose.
      Drimycarpus spp. *(p.p.)*.
      Nothopegia castaneaefolia (p.p.).
      Melanochyla: axillaris, beccariana, bullata, densiflora, elmeri, kunstleri (pl. I, 1), *semecarpoides.*
      Rhus chinensis.

Semecarpus: aruensis (pl. IV, 7), *bunburyanus* (pl. IV, 8), *glaucus* (pl. I, 2), *cuneiformis, heterophyllus (p.p.), magnificus, paucinervius, rufovelutinus.*
Swintonia: glauca, minutalata, schwenkii (p.p.), spicifera (p.p.).

B2. Areoles papillose but veins in and surrounding areoles not or only partly papillose.
Melanochyla: borneënsis (pl. II, 4), *caesia, fulvinervis.*
Semecarpus: bracteatus (pl. III, 6), *cassuvium* (pl. II, 3), *forstenii, heterophyllus (p.p.), longifolius (p.p.), lucens, papuanus (p.p.), trachyphyllus* (pl. III, 5).

BOUEA

Bouea is the only genus of the *Anacardiaceae* with decussate simple leaves.

The leaves are very variable both in shape and size, and most of the 'species' described were mainly based on these characters. However, the flowering and fruiting characters are rather uniform.

I examined the pollen grains of the two species treated in the Flora Malesiana and they appear to be similar both in morphological characters and in size.

BUCHANANIA

Subdivision. Based on characters of the stamens, Engler (in DC., Mon. Phan. 4, 1883: 180—181) divided the genus *Buchanania* into two series. The essential characters as given by him, the lectotype species which were chosen by me, and the Malesian representatives of each of the series are listed below.

I. *Buchanania* ser. *Adnatae* Engl., op. cit. 180.
Filaments of stamens narrowly linear, lower part of anthers hardly narrowed; anthers almost adnate, ovate or oblong-ovate, thecae not elongated into prominent lobes to the base. — Lectotype: *B. latifolia* Roxb.
Malesian representatives: *B. microphylla, B. splendens.*

II. *Buchanania* ser. *Sagittatae* Engl., op. cit. 181.
Filaments of stamens narrowly or broadly linear, often subulate upwards; anthers sagittate, thecae more or less elongated into lobes. — Lectotype: *B. sessifolia* Bl.
Malesian representatives: *B. insignis, B. arborescens, B. amboinensis, B. macrocarpa, B. nitida, B. sessifolia.*

Wilkinson (Leaf anatomy of various *Anacardiaceae* with special reference to the epidermis, Ph.D. thesis, Univ. London, 1971: 54—73, not published) divided the nine *Buchanania* species she studied into two groups based on the arrangement of subsidiary cells. It is interesting that these two groups correspond to the two series of Engler.

1. B. microphylla Engl.

A flowering specimen of this species, *BS 41468* (SING) from Luzon, Philippines, was distributed as *Wikstroemia indica* L. (*Thymelaeac.*).

Three Philippine collections, all in flower, *BS 20887* (BO, L), *FB 2791* (BO), and *FB 23858* (BO), were identified and distributed as *B. microphylla*, and the last one was also cited under this species by Merrill (En. Philip. 2, 1923: 466). At first glance they seem to be rightly named. However, they all have sagittate stamens and distinctly belong to *B. arborescens* (Bl.) Bl.

2. Buchanania sessifolia Bl.

B. sessifolia Bl., Mus. Bot. Lugd.-Bat. 1 (1850) 184. — Lectotype: *Korthals 1034* (L), Sumatra; syntype: *Korthals 1120* (L), Sumatra.

For the specific epithet of the present species, Blume used the same word '*sessifolia*' both in publication and in writing on the authentic collections cited above. Miquel (Fl. Ind. Bat. 1, 2, 1859: 637) changed it for a better Latin word '*sessilifolia*'. Following the Code (ed. 1972, Art. 73), the original spelling '*sessifolia*' is retained.

The specimens *Lobb 342* (not seen) and *422* (W), cited under *B. sessifolia* ('*sessilifolia*') by Engler (in DC., Mon. Phan. 4, 1883: 191) from Herbarium DC., were recorded to have been collected in Java. So far, I have not seen any other collection of this species from Java. Since Lobb's collections often have labels with incorrect localities, these two specimens are probably mislocalized.

CAMPNOSPERMA

The generic name *Campnosperma*, formed by the combination of two Greek words: '*kamptein*' and '*sperma*', means the plant with 'curved seeds'. The ending '*-ma*' in '*-sperma*' is neuter, and so is the generic name derived from it (cf. Stearn, Bot. Latin, 1966: 264—265).

When Thwaites (in Hook., J. Bot. Kew Misc. 6, 1854: 65) established the genus *Campnosperma*, he treated it rightly as neuter, as indicated by the gender of the specific epithet, *C. zeylanicum* Thw. According to the Code (ed. 1972, under Recommendation 75A), a Greek word 'adopted as a generic name should retain its gender', so the original endings of some of the specific epithets in this genus have been altered.

1. Campnosperma auriculatum (Bl.) Hook. *f.*

Buchanania auriculata Bl., Mus. Bot. Lugd.-Bat. 1 (1850) 185. — Lectotype: *Korthals 779* (L), Sumatra; syntype: *Müller s.n.* (L, sheet no. *897.363—236*), Borneo.

Buchanania? oxyrhachis Miq., Sum. (1861) 524. — Type: *Teysmann HB 851* (U; iso in BO), Sumatra.

2. Campnosperma coriaceum (Jack) Hall. *f. ex* Steenis

Coelopyrum coriaceum Jack, Malay. Misc. 2, 7 (1822) 65, *ex descript.* — Type: *Jack s.n.* (unknown), Sumatra.

Buchanania macrophylla Bl., Mus. Bot. Lugd.-Bat. 1 (1850) 185. — Lectotype: *Korthals 1309* (L), Sumatra; syntypes: *Korthals s.n.* (L, sheet no. *897. 363—247*), Sumatra; *Müller s.n.* (L, sheet no. *897.363—246*), Borneo.

Buchanania racemiflora Miq., Sum. (1861) 523. — Type: *Teysmann s.n.* (U), Bangka.

3. Campnosperma montanum Lauterb., Bot. Jahrb. 56 (1920) 359. — Lectotype: *Ledermann 9898* (WRSL; iso in L), New Guinea; syntype: *Ledermann 12936* (WRSL), New Guinea.

THE ORIGIN OF TIGASO-OIL

'Tigaso-' or 'Tegaso-oil' was reported to be extracted from the wood of *Campnosperma coriaceum* (Robbins & Pullen, Land Res. Ser. CSIRO 15, 1965: 108) and *C. brevipetiolatum* (Paijmans & Pullen, ditto, 23, 1969: 128) in Papua.

One specimen, *Schodde 2300*, in the Rijksherbarium, Leiden, with only one detached leaf, was collected from a tree of *c.* 29 m high and 76 cm ∅, on the margin of *Metroxylon* swamp and primary forest, at *c.* 750 m alt., near Wasemi, Lake Kutubu, Southern Highlands Dist., Papua. In the field note the tree was recorded as 'planted', with local name 'Tigaso (Kutubu language)' and the 'sap used for oil by natives'. This leaf is oblanceolate,

46 by 12.5 cm, and the base is broadly decurrent; it has no distinct auricles. In order to ascertain the origin of the 'tigaso-oil', the sheet of this collection in the Herbarium Australiense, Canberra, was asked on loan. In a letter dated 24 March 1976, Dr Hj. Eichler informed us that the sheet in Canberra 'bears two detached leaves' similar to the one in Leiden.

This collection is probably *C. brevipetiolatum*. However, it may belong to *C. montanum* (*cf. NGF 17738 & 39416*). Its identity is of importance to ascertain the origin of the 'tigaso-oil', but it cannot be identified with certainty, because detached leaves or leaves on young (sterile) twigs, without distinct auricles, of *C. brevipetiolatum* are similar to the (big) vegetative leaves of *C. montanum*.

It is not known whether *C. montanum* also yields a similar oil.

DRACONTOMELON

D. dao (Blanco) Merr. & Rolfe

The name *Poupartia mangifera* Bl. (Bijdr. 1826—27: 1160) is illegitimate because three earlier ones, viz. *Mangifera pinnata* L.*f.* (1781), *Spondias mangifera* Willd. (1799), and *Spondias amara* Lamk (1796), were cited in the synonymy, and the earliest legitimate epithet available for the taxon was not adopted (*cf.* Code, ed. 1972, Art. 67).

Blume (Mus. Bot. Lugd.-Bat. 1, 1850: 231) was later apparently aware that his species differed from those cited in the synonymy above. When the genus *Dracontomelon* Bl. was established, he described the species *D. mangiferum*, based on *Poupartia mangifera* Bl. *sensu stricto* as indicated by adding '(*excl. syn. omnia*!)' (literally = 'excl. syn. entirely!'); he transferred the three synonyms of the latter cited above to *Evia amara* (cf. Blume, op.cit. p. 235) (= *Spondias pinnata*). By omitting these three synonyms he intended to say that his *Poupartia mangifera* should be seen as a new species, not as a new combination.

The epithet '*mangiferum*' in *D. mangiferum* Bl. can only be used now if it is treated as a new name, dating from 1850 (cf. Code, ed. 1972, example under Art. 72). Unfortunately Blume (1850: 231) cited under this name also the earlier *Poupartia pinnata* Blanco (1837, presumably a new sp.) in the synonymy and did not adopt its epithet. Nomenclaturally, the commonly used name *D. mangiferum* Bl. is hence also illegitimate for the same reason as given above. It has to be replaced by the name *D. dao* (Blanco) Merr. & Rolfe. Taxonomically, *Poupartia pinnata* Blanco is a synonym of *Spondias pinnata* (L.*f.*) Kurz (cf. Airy Shaw & Forman, Kew Bull. 21, 1967: 8).

EXCLUDED SPECIES

Dracontomelon papuanum Lauterb. in K. Sch. & Laut., Nachtr. (1905) 301; Bot. Jahrb. 56 (1920) 356. — Type: *Schlechter 14287* (iso in WRSL). = *Protium macgregorii* (F. M. Bailey) Leenh. (*Burseraceae*).

The type of *D. papuanum* Lauterb. was collected near Constantinhafen, former Kaiser-Wilhelmsland (NE. New Guinea), March 1902. Fortunately, I had some authentic material on loan from Wroclaw (WRSL), Poland, which consists of a carbon rubbing print of the type, some loose flowers, and original drawings made by Lauterbach. When I examined the material, I found that it belongs to the *Burseraceae*. The final identification was made by Dr P. W. Leenhouts.

DRIMYCARPUS

Drimycarpus luridus (Hook. *f.*) Ding Hou, *comb. nov.*

?*Semecarpus lurida* Hook. *f.*, Fl. Brit. Ind. 2 (1876) 34; Engl. in DC., Mon. Phan. 4 (1883) 496. — *Swintonia lurida* King, J. As. Soc. Beng. 65, ii (1896) 491; Ridl., Fl. Mal. Pen. 1 (1922) 533. — Type: *Maingay 495* (K), ♂ fl., Malacca.
Semecarpus glabra Ridl., Fl. Mal. Pen. 5 (1925) 303. — Type: *Curtis 3594* (K; iso in SING), ♂ fl., Penang.

Further specimens examined:

SUMATRA. North Sumatra: Sibolangit, fl., *Lörzing 6842* & *12867* (L). — East Coast: Koealoe, fl., *Bartlett 7346* (L). — Karimoen: veg., *bb 17070* (BO). — Indragiri: fl., *bb 28506* (BO, L).
MALAY PENINSULA. Perak: fl., *Wray Jr. 3249* (K, SING). — Malacca: Bukit Naning, veg., *Alvins 899* (SING).
BORNEO. Sarawak: Mt Mersing, Anap, *Sibat ak Luang*, fr., *S 21890*, fl., *S 21980*, & fr., *S 22107* (L). — Sabah: Kudat, Banggi I., fl., *Lajangah & Jinik Chong SAN 36113* (K, L); Sandakan, Sepilok For. Res., fl., *Aban Gibot SAN 73678* (L); Kinabatangan, fl., *Wood SAN A4750* (L, SING); Lahad Datu, Pulau Sakar, fr., *Agam & Aban Gibot SAN 36038* (K, L), fl., *Aban Gibot SAN 54813* (L). — E. Indon. Borneo: E. Kutei, fr., *Kostermans 7231* (BO, L).

In 1876, Hooker *f.* published a new species, '?*Semecarpus lurida*', from the Malay Peninsula. He placed a question mark before the name to indicate the doubtfulness of the generic determination. Engler (l.c.) in his monograph of the family *Anacardiaceae* excluded this species from *Semecarpus* and stated that because the female flowers and fruits were not at hand, the identification of the plant to the proper genus was not possible. In 1896, King thought to have good (♂) flowering specimens (*Wray Jr. 3249*) 'of exactly the same plant' like the collection of *Maingay*, referred them to the genus *Swintonia*, as *S. lurida*, and stated that 'its nearest allies being *S. floribunda* and *S. schwenkii*'.

Ridley (1922) accepted King's treatment of Hooker's species in his Flora of the Malay Peninsula. In 1925 he had a (♂) flowering specimen (*Curtis 3594*) similar to those of that species, but described it as a new species under *Semecarpus*, *S. glabra*, in the same Flora.

So far I have not seen collections of this plant in ♀ flower or fruit from the Malay Peninsula.

There are similar collections of this plant in either ♂ flower or fruit from Sumatra and Borneo. The fruit develops from an inferior ovary and is crowned by the persisting floral parts. After having studied the collections cited above, I found that they belong neither to *Swintonia* nor to *Semecarpus*.

On my visit to the Kew Herbarium in 1973, through the help of Mr L. L. Forman, the collections in question were identified as belonging to *Drimycarpus* Hook. *f.* (also *Anacardiaceae*), a genus which was until now assumed to be monotypic and only occurring in India, Sikkim, Bhotan, the Himalayan area, Burma, Thailand, and Vietnam. The Malesian plant belongs to a second species of the genus, *D. luridus*. The geographical range of this genus is now extending to west Malesia: a new record for the flora of this area.

Sterile collections or specimens with only ♂ flowers of *D. luridus* are very difficult to name with certainty.

D. luridus is closely allied to the extra-Malesian species *D. racemosus* (Roxb.) Hook. *f. ex* March. but can be distinguished from it by the following characters: 1) leaves usually without transverse veins in the intercostal area (against leaves with several to many such veins), 2) leaves with 1 or more internerval veins shorter than the nerves but parallel to them (against leaves usually without such veins), 3) inflorescences terminal or in axils at the end of twigs, up to 20 cm long, much-branched (against inflorescences usually axillary, up to 2.5(—8) cm long, few-branched), 4) petals rather fleshy, veins invisible (against petals thin, veins distinct), and 5) stamens unequal in length, sometimes 2 long and 3 short (against stamens usually equal in length).

GLUTA

Gluta L., Mant. 2 (1771) 293; Gen. Pl., ed. 8 (1789) 146; Blume, Mus. Bot. Lugd.-Bat. 1 (1850) 182; Hook. *f.* in Benth. & Hook. *f.*, Gen. Pl. 1 (1862) 421; March., Rév. Anacar. (1869) 110 & 187; Hook. *f.*, Fl. Brit. Ind. 2 (1876) 21; Engl. in DC., Mon. Phan. 4 (1883) 224; in E. & P., Pfl. Fam. III, 5 (1892) 148; King, J. As. Soc. Beng. 65, ii (1896) 480; Ridl., Fl. Mal. Pen. 1 (1922) 526; I. H. Burk., Gard. Bull. S.S. 5 (1931) 224; Tard., Fl. L.C. & V. 2 (1962) 114. — Type: *G. renghas* L., *sphalm.* '*Benghas*'.

Stagmaria Jack, Desc. Mal. Pl. 3 (1822) 12, reprinted in Hook. Comp. Bot. Mag. 1 (1836) 267; Endl., Gen. Pl. (1840) 1132. — Type: *S. verniciflua* Jack (= *Gluta renghas* L.).

Syndesmis Wall. in Roxb., Fl. Ind., ed. Carey, 2 (1824) 314; Endl., l.c. — Type: *S. elegans* Wall. (= *Gluta elegans* Hook *f.*).

Melanorrhoea Wall., Pl. As. Rar. 1 (1829) 9; Endl., l.c.; Hook. *f.* in Benth. & Hook. *f.*, l.c.; March., op. cit. 112 & 185; Hook. *f.*, Fl. Brit. Ind. 2 (1876) 25; Engl. in DC., op. cit. 234; in E. & P., l.c.; King, op. cit. 483; Ridl., op. cit. 528; Tard., op. cit. 102. — Type: *M. usitata* Wall. (= *Gluta usitata* Ding Hou).

Melanorrhoea sect. *Pentandrae* Engl. in DC., l.c.; in E. & P., l.c. — Lectotype: *M. wallichii* Hook. *f.* (= *Gluta wallichii* Ding Hou).

Melanorrhoea sect. *Pleiocyclae* Engl. in DC., op. cit. 236; in E. & P., l.c. — Type: type species of the genus.

Melanorrhoea sect. *Eumelanorrhoea* King., l.c. — Type: type species of the genus.

Melanorrhoea sect. *Apterae* King. l.c. — Type: *M. aptera* King (= *Gluta aptera* Ding Hou).

As a consequence of the reduction of *Melanorrhoea* to *Gluta*, this genus now consists of about 30 species distributed in Madagascar (1 sp.), India (1 or 2 spp.), Burma (3 or 4 spp.), Thailand (*c.* 10 spp.), Indochina (9 spp.), China (?Hainan, 1 sp.) and throughout Malesia (22 spp.; not yet found in the Philippines). Among these species five new ones have been described from Malesia; furthermore eleven necessary new combinations have been made.

DELIMITATION AND SUBDIVISION

The genus *Gluta* was established by Linnaeus (1771) with one Javanese species, *G. renghas*, commonly known by the name *rengas* or *renghas* which was adopted for the specific epithet. It has a gamosepalous calyx, 5 petals, 5 stamens, and a stipitate ovary (*cf.* Linnaeus, 1789). The gamosepalous calyx was then a unique generic character in the *Anacardiaceae*. Since then *Gluta* has been maintained as a distinct genus.

In 1822, Jack described *Stagmaria* from Sumatra; Endlicher (1840) expressed the opinion that this genus is hardly different from *Gluta*. In 1824, Wallich published *Syndesmis* based on a plant from Penang Island. These two genera were rightly reduced to *Gluta* by Blume (1850).

The genus *Melanorrhoea* was described by Wallich (1829) and based on a Burmese plant, *M. usitata*, the Burmese varnish tree. It is characterized by: 1) calyx calyptriform, caducous, 2) petals 5, enlarged (wing-like) in fruit, 3) stamens many (20—30), 4) torus convex, and 5) ovary stipitate, 1-loculed, 1-ovuled.

In 1832, Wallich (Pl. As. Rar. 3, p. 50, t. 283) added another new species, *M. glabra*. Since then its generic limit has been modified. It has been accepted as a distinct genus until now and there are more than 20 species.

As early as in 1869, Marchant in his study of the *Anacardiaceae*, expected that perhaps one day somebody would unite *Melanorrhoea* with *Gluta*. However, he also stated that the number of stamens, swollen disk (= torus), and accrescent petals were sufficient reasons to maintain its independence.

In 1876, Hooker *f.* considered the 'much enlarged petals in fruit' as an important generic character for *Melanorrhoea* and added two new species with only 5 stamens to the genus which till then consisted only of species with many stamens.

Engler (1883) accepted the modified generic concept of Hooker *f.* and divided this genus accordingly into two sections, based on the number of stamens and other characters, viz. sect. *Pentandrae* Engl. — 'Stamens 5, inserted on the thickened floral axis. Ovary on a

short disk...' (*M. maingayi* Hook. *f.* & *M. wallichii* Hook. *f.*) and sect. *Pleiocyclae* Engl. — 'Stamens many, 4—5-whorled, inserted on a thickened, globose floral axis. Ovary on a thin gynophore, subexserted beyond the stamens...' (*M. macrocarpa* Engl., *M. glabra* Wall., *M. usitata* Wall., & *M. beccarii* Engl.).

In 1896, in addition to Hooker's modification regarding the number of stamens for the generic circumscription, King went still further to modify the generic concept; he added two new species with deciduous petals to the genus which had species till then all with persistent and enlarged petals in fruit, and he described a new one with 10 stamens, *M. curtisii*. He divided the genus into two sections for the Malayan species mainly based on the character of petals: sect. I. *Eumelanorrhoea* King — 'Petals accrescent in the fruit' (*M. wallichii* Hook. *f.*, *M. curtisii* King, *M. maingayi* Hook. *f.*, *M. woodsiana* Scort. *ex* King, & *M. torquata* King); sect. II. *Apterae* King — 'Petals not accrescent in the fruit' (*M. aptera* King & *M. inappendiculata* King). King evidently did not know of Engler's publication and his two sections cited above. In his key to the genera of the *Anacardiaceae* (1896: 460), he placed the genus *Melanorrhoea* under the heading of 'Petals accrescent', and apparently forgot to consider his two new species with deciduous petals.

Merrill (J. Str. Br. R. As. Soc. 77, 1917: 190) described the second species bearing 10 stamens, *M. oba*, with a stipitate ovary and without enlarged petals in fruit.

In 1922, Ridley, in his Flora of the Malay Peninsula, followed King's treatment of *Gluta* and *Melanorrhoea* as mentioned above but overlooked the discrepancy between the latter's key to the genera and his text, and repeated the error by placing *Melanorrhoea* under the heading of 'Petals accrescent'.

Tardieu-Blot (1962: 114—115), in her study of Indochinese *Anacardiaceae*, stated in the observation under *Gluta* that the generic limit is sometimes rather difficult to define between *Gluta* and the sect. *Pentandrae* of *Melanorrhoea* (with also 5 stamens: *M. maingayi* and *M. wallichii*). According to her, the calyx can give a good character; however, she also found that in the species *G. compacta* Evrard the condition of the calyx is intermediate between splitting into two, spathaceous, as in *Gluta*, and calyptriform, entirely united and caducous in one piece, as in *Melanorrhoea*. Furthermore she said that the ovary appears to give a better character: the style is terminal in *Melanorrhoea* and excentric in *Gluta*; the floral axis is ± globose in *Melanorrhoea*, whereas the ovary is distinctly stipitate in *Gluta*.

Tardieu-Blot's statement mentioned above concerning the characters useful for the delimitation of the genera *Gluta* and *Melanorrhoea* holds good only for some species. For example, in her revision of the *Anacardiaceae*, the ovary of the two species of *Melanorrhoea*, *M. usitata* and *laccifera*, was described as stipitate (op. cit. 103 & 104), but in her key to the genera of the tribe *Mangifereae* it was described as 'sessile' (op. cit. 71). If she had examined the Malesian species, she might have reduced *Melanorrhoea* to *Gluta*.

In the course of my revision of the Malesian *Anacardiaceae*, I tried to clarify the generic limits of *Gluta* and *Melanorrhoea*. In gross morphological characters, the species of these two genera appeared to have more similarities than differences. They show reticulate relationships and cannot be separated satisfactorily into two natural groups; hence, I concluded to reduce *Melanorrhoea* to *Gluta*. By arbitrarily selecting one of the following characters: for example, number of stamens (5, 10, and ∞), cotyledons free or partly fused, shapes of splitting calyx at anthesis, petals enlarged in fruit or not, ovary stipitate or sessile, style terminal or excentric, etc., the species concerned can be grouped in various ways (cf. Table 1); so I refrained from proposing an infrageneric subdivision.

COALESCENT COTYLEDONS

In many *Gluta* species the two massive cotyledons of a dried seed are hard and free, and can easily be separated from each other; however, they are apparently laterally and longitudinally united (cf. fig. 1, g & h) in other species as observed by the naked eye or under a dissecting microscope.

As early as 1822, Jack (l.c.) described that the cotyledons of *Stagmaria verniciflua* (= *G. renghas*) are 'united, having a fissure on one side'. Wallich (Pl. As. Rar. 1, 1829: 12) referred this species as having 'a pseudo-monocotyledonous embryo'. This kind of cotyledons has also been recorded for *G. renghas* by later botanists, for example, Blume (1850, l.c., also his fig. 39), Backer (Fl. Bat. 1, 1907; 367).

While working on this genus I found that the united cotyledons also occur in the following species: *G. capituliflora, elegans, lanceolata, laxiflora* (fig. 1, g & h), *papuana, sabahana, tavoyana, wrayi*. The united part of the cotyledons varies from 1/6 (*G. papuana*) to 9/10 (*G. renghas*) of the width of the embryo. This feature of the cotyledons can be useful as an additional diagnostic character.

On a seedling, the united cotyledons (remaining in the fruit) are at one side of the stem as was observed in *G. renghas* (*FRI-T819*, BO; Burger, Seedl. Trop. Trees Shrubs SE. Asia, 1972, fig. 3), *G. lanceolata* (*Pagden s.n.*, SING, sheet no. *016971*), and *G. laxiflora* (*Ding Hou 319*, L).

United cotyledons have been recorded also in other families. Burger (op. cit. 283—300, figs. 111b, 112b & f, 113b, 115b, 117b) stated that the cotyledons are 'connate, forming a cotyledon-body' in species of *Bruguiera, Ceriops*, and *Rhizophora* (all *Rhizophoraceae*). Pennington (Blumea 22, 1975: 485, 488, 524, 525) described that the cotyledons of *Aphanamixis, Sphaerosacme, Carapa*, and *Xylocarpus* (all *Meliaceae*) are 'completely fused' or 'fused together'. Corner (Seeds Dicots. 1, 1976: 187) also recorded that the cotyledons of *Carapa* are 'more or less connate'.

Contrary to what is recorded above, Burger (op. cit. 30, fig. 3; 256, fig. 102) described the cotyledons of *G. renghas* and *Xylocarpus granatum* as 'their upper surfaces in close contact'. In order to verify whether the cotyledons of the above mentioned taxa are really connate or just in close contact, anatomical study of various developmental stages of the seed is desirable.

ANATOMICAL STUDIES

Mr L. S. V. Murthy, Forest Department, Kuching, Sarawak, told me that from the wood-anatomical point of view, there is no distinction between *Gluta* and *Melanorrhoea*; if they are treated as one group, it is distinct and can be distinguished from other related genera of the *Anacardiaceae*. Mr P. K. Balan Menon, Forest Research Institute, Kepong, Malaya, also expressed to me a similar opinion.

Wilkinson (Leaf anatomy of various *Anacardiaceae* with special reference to the epidermis, 1971: 626 pp., with many plates and figs, Ph.D. thesis, Univ. London, not published), in her comprehensive study of the leaf-anatomy of this family, examined two species of *Gluta* (*G. renghas* & *G. velutina*) and three species of *Melanorrhoea* (*M. aptera, M. wallichii*, & *M. woodsiana*). Her study will be reviewed under the chapter on anatomy of this family in the Flora Malesiana. As for the specimens investigated, these two genera appear to differ anatomically in (simple) trichomes (absent in *Gluta* but present in *Melanorrhoea*; cf. the key in her thesis on p. 77) and stomatal characters (cf. her thesis pp. 74—84, 112). It would be interesting to have the results of studies on more species.

SEPALS		GAMOSEPALOUS			
CALYX AT ANTHESIS		FALLING OFF IN ONE PIECE (CALYPTRIFORM)		BURSTING IRREGULARLY, TOOTHED OR LOBED, AND/OR SPLITTING ON ONE SIDE (SPATHACEOUS)	
PETALS		NOT ENLARGED IN FRUIT	ENLARGED IN FRUIT	NOT ENLARGED IN FRUIT	ENLARGED IN FRUIT
STAMENS 5		malayana ?compacta	malayana	*sabahana *wrayi *renghas *laxiflora *lanceolata *tavoyana *elegans *capituliflora *papuana velutina torquata travancorica obovata ?gracilis tourtour ?compacta	wallichii
STAMENS (8–)10		oba	curtisii		
STAMENS	c. 40 – c. 20	macrocarpa laccifera	usitata glabra rugulosa macrocarpa laccifera		
STAMENS	c. 70 – c. 60	pubescens	beccarii pubescens		
STAMENS	c. 100 OR MORE	rostrata speciosa aptera			

Table 1. Inter-relationships of *Gluta* species. — Species with 1/6—9/10 fused cotyledons marked*, in the other species cotyledons separated completely (if unknown, indicated by a question mark). — If petals not to slightly enlarged in fruit, the species listed under both headings. — Two incompletely known species (*G. cambodiana* and *G. megalocarpa*) omitted.

PALYNOLOGICAL STUDIES

Baksi (in Ferguson & Muller, eds: The evolutionary significance of the exine, Linn. Soc. Symp. Ser. no. 1, 1976: 379—405, pl. 1—8, f. 1 & 2) made an intensive study on the pollen morphology of *Gluta* and *Melanorrhoea*. He examined samples of most of the species. His study will be reviewed under the chapter on pollen morphology of *Anacardiaceae* in the Flora Malesiana. The following short account is limited to the results related to taxonomy.

According to him, there is a basic ('*curtisii*') type which 'gave rise to two divergent phylogenetic trends', A & B (his fig. 1). The '*curtisii*' type consists of 12 species originally described under either *Gluta* or *Melanorrhoea*: 3 spp. with stamens ∞, 2 spp. with stamens 10, and 7 spp. with stamens 5. The trend A comprises 4 types belonging to 7 species originally described under *Melanorrhoea*, from the basic type to the derived types in the following sequence: '*torquata*' (1 sp. with stamens 5), '*beccarii*' (1 sp. with stamens ∞=*c.* 70), '*speciosa*' (4 spp. with stamens ∞=*c.* 100 or more), and 'macrocarpa' (1 sp. with stamens ∞ =*c.* 20). The trend B comprises 4 types belonging to 9 species, all with stamens 5, all except one being originally described under *Gluta*, from the basic type to the derived types in the following sequence: '*woodsiana*' (1 sp.), '*laxiflora*' (1 sp.), '*wrayi*' (3 spp.), and '*elegans*' (4 spp.).

In his Fig. 2, he included the '*torquata*' and '*woodsiana*' types, both with 5 stamens, from trends A and B respectively, in the '*curtisii*' type to form the 'basic complex', which now consists of 14 species; so the trends A and B, also together with 14 species, 'conform to the generic differentiation'.

Based on his study, Baksi (op.cit. 395) concluded: 'Although the end products are clearly separable, both pollen morphologically and macromorphologically, it is not possible to delimit the two genera within the basic complex on pollen morphology'.

It is evident that the genera *Gluta* and *Melanorrhoea* also cannot be separated by using pollen morphological characters.

FOSSIL LEAF

A fossil leaf collection of lower Ravenian (lower upper Eocene) from the Gulf of Alaska region was described as *Semecarpus alaskana* Hollick. Wolfe (Paleogene floras from the Gulf of Alaska region, US Dept Inter. Geol. Survey, open file report, 1969: 45 & 46, t. 6, f. A—C) renamed it as *Melanorrhoea sp.*, evidently because its marginal ultimate venation, recurved to form loops, is similar to that of the modern material which he had obtained from North Borneo named as *M. macrocarpa* Engl.

The marginal leaf venation is rather similar in *Semecarpus*, *Melanorrhoea* (=*Gluta*), and *Melanochyla*. Even if this fossil collection would belong to *Anacardiaceae*, it could hardly be referred to one of the genera just mentioned.

NEW SPECIES AND NEW COMBINATIONS

1. **Gluta aptera** (King) Ding Hou, *comb. nov.*

Melanorrhoea aptera King, J. As. Soc. Beng. 56, ii (1896) 487. — Syntypes: *King's Coll. 3485* (BM, K, L), *3727* (K, SING), *7656* (SING), Perak; *Curtis 1567* (SING), Penang.

Melanorrhoea inappendiculata King, op. cit. 488. — Syntypes: *King's Coll. 5418* (K), Perak; *Curtis 2475* (K, SING), Penang.

Melanorrhoea tricolor Ridl., Kew Bull. (1933) 196. — Type: *Haviland 2231* (K; iso in L), Sarawak.

2. Gluta beccarii (Engl.) Ding Hou, *comb. nov.*

Melanorrhoea beccarii Engl., Bot. Jahrb. 1 (1880) 45. — Type: *Beccari PB 1484* (iso in K), Borneo.

3. Gluta capituliflora Ding Hou, *spec. nov.*

G. cambodiana auct. non Pierre: I. H. Burk., Gard. Bull. S.S. 5 (1931) 229.

Arbor usque 24 m alta et 49 cm diam. *Folia* elliptica ad anguste elliptica, vel lanceolata, 5—17.5 × 1—5.5 cm, basi cuneata ad attenuata, apice acuta ad acuminata, nervis 6—14 paribus, petiolo 1—2(—3) cm longo. *Inflorescentiae* laxae, 8—10.5 cm longae, puberulae. *Flores* subsessiles, ad apices ramulorum aggregati. *Calyx* irregulariter ruptus, spathaceus, 4—5 mm longus, extus puberulus. *Petala* anguste elliptica, 9—10 × 1.7—2 mm, in fructu non aucta, deciduus, extus puberula. *Torus* 3.5—4 mm longus. *Stamina* 5, 5—7 mm longa; antherae oblongae, 0.5—0.7 mm longae. *Gynophorum* 1—1.5 mm longum. *Ovarium* glabrum, oblique ellipsoideum, *c.* 1 mm longum, stylo excentrico, 3—4 mm longo. *Drupa* fere horizontaliter reclinata; embryo leviter reniformis, 5.5—7 × 3.5—4.5 × 2.5—3 cm; cotyledones imperfecte connatae, parte libero 2.7—3.7 cm profundo.

Typus: Malay Peninsula. Kelantan: Sg. Keteh near Gua Ninik, fl., *Henderson SF 19657* (SING; iso in K).

Further specimens examined:

MALAY PENINSULA. Trengganu: Dungun, Bt Bank For. Res., fr., *Chelliah KEP 104375* (L); Ulu Dungun near Bebir, fr., *Wong Swee Min FRI 9622* (L); 38th mile Kuala Trengganu — Besut Road, West side, fr., *Sinclair & Kiah b. Salleh SF 39966* (K, L, SING).

Ecology. In primary forests, sometimes occurring on riverbanks; up to 300 m alt.

Notes. The flowering type specimen *SF 19657* was provisionally identified as *G. cambodiana* Pierre (so far known with flowering material) by Burkill (l.c.) who also stated that for certainty more material especially with fruit was desirable. It differs from specimens of *G. cambodiana* by the subsessile flowers crowded at the end of branchlets and by the glabrous ovary with a distinct gynophore. It represents a new species, *G. capituliflora*, and the specific epithet alludes to the aggregate flowers. The new species is closely allied to *G. cambodiana* (cf. Pierre, Fl. Coch. 1897: t. 368, B; Tard., Fl. C.L. & V. 2, 1962: 119).

There are three fruiting collections and their vegetative characters match those of *SF 19657*. The characteristic fruit is broad-ellipsoid, buff, scurfy, and bending horizontally. The embryo is slightly reniform and the cotyledons are incompletely united.

4. Gluta curtisii (Oliver) Ding Hou, *comb. nov.*

Melanorrhoea curtisii Oliver in Hook., Ic. Pl. 16 (1886) t. 1513. — Type: *Curtis 242* (K; iso in SING), Penang.

The type of the present species was collected from Government Hill, Penang, by Curtis, in May 1885. There are several collections from the same locality made by the same collector, but later than 1885. Two of them were also numbered as '*242*', one as '*=242*', and one is without a number. These might have been collected from the same tree as the type specimen.

5. Gluta glabra (Wall.) Ding Hou, *comb. nov.*

Melanorrhoea glabra Wall., Pl. Asia. Rar. 3 (1832) 50, t. 283; Hook. *f.*, Fl. Brit. Ind. 2 (1876) 25; Kurz, Fl. Burm. 1 (1877) 317; Engl. in DC., Mon. Phan. 4 (1883) 236. — Type: *Wallich Cat. 1005* (K), Tavoy, Burma.

The original description was based only on a flowering collection. Fruiting material was later available to Hooker *f.* (l.c.). The fruit is globose, *c.* 1.2 cm Ø, with a rather long stalk (2.5—2.7 cm long), and supported by the enlarged, linear-oblong or -spathulate petals (*c.* 6 × 2 cm).

In addition to the type, I have examined the following Burmese specimens in the Kew Herbarium: *Lace 2762*, *Parker 2323*, and *Griffith 728*.

6. **Gluta laccifera** (Pierre) Ding Hou, *comb. nov.*

Melanorrhoea laccifera Pierre, Bull. Soc. Linn. Paris 1 (1885) 538; Fl. Coch. (1897) t. 367 A; Tard., Fl. C.L. & V. 2 (1962) 104. — Type: *Herb. Pierre 915* (P, *n.v.*), Cambodia.
Melanorrhoea pilosa Lecomte, Bull. Soc. Bot. Fr. 54 (1908) 608. — Type: *Thorel 2726* (P, *n.v.*), Laos.

Pierre's detailed description and drawings of *M. laccifera* give no difficulty to recognize this distinct species. I have not seen the type, but examined a duplicate of *Pierre 1654* (L) from Cambodia cited in his Flora and four flowering collections from Thailand: *Vesterdal 4D, 490*, *Burkill 1260A*, and *Duang Saman 2581* (SING). This species is characterized by stamens *c.* 30, globose fruit *c.* 3—4 cm Ø with an almost centric stalk (*c.* 1.5 cm long), and small enlarged petals (*c.* 1.5 cm long) in fruit. I follow Tardieu-Blot for the reduction of *M. pilosa* to the present species.

7. **Gluta macrocarpa** (Engl.) Ding Hou, *comb. nov.*

Melanorrhoea macrocarpa Engl. in DC., Mon. Phan. 4 (1883) 236. — Type: *Beccari PB 3051* (iso in K) Borneo.

8. **Gluta malayana** (Corner) Ding Hou, *comb. nov.*

Melanorrhoea malayana Corner, Gard. Bull. S. S. 10 (1939) 261. — *M. pilosa* Ridl., Kew Bull. (1931) 448, *nom. illeg.*, *non* Lecomte (1908). — Type: *Lambak CF 2739* (K), Pahang.

9. **Gluta oba** (Merr.) Ding Hou, *comb. nov.*

Melanorrhoea oba Merr., J. Str. Br. R. As. Soc. 77 (1917) 190. — Type: *Villamil 316* (K, SING), N., Borneo.

10. **Gluta papuana** Ding Hou, *spec. nov.*

Arbor usque 31 m alta et 42 cm diam. *Folia* elliptica, late elliptica, vel obovato-oblonga, 7—20.5 × 3—10.5 cm, basi cuneata, apice rotundata, leviter emarginata, raro cuspidata, nervis 12—17 paribus, petiolo 1—2.5 cm longo. *Inflorescentiae* usque 30 cm longae, leviter puberulae, glabrescentes; pedicelli articulati, 1—3 mm longi. *Calyx* irregulariter ruptus, spathaceus, 3—3.5 mm longus, apice leviter puberulus. *Petala* elliptica vel obovato-oblonga, 6.5—7.5 × 2.5—3 mm, in fructu non aucta, decidua. *Torus* 0.7—1.2 mm longus. *Stamina* 5 (vel 6), 4.5—5 mm longa; antherae oblongae, c. 1 mm longae. *Gynophorum* 0.7—1.2 mm longum. *Ovarium* subglobosum, vel late ellipsoideum, c. 0.7 mm diam., stylo excentrico, 2—2.5 mm longo. *Drupa* leviter reniformis, 6.5—8 × 5—5.5 × 2—2.5 cm, laevis, nitida, fere horizontaliter reclinata; embryo reniformis, 3.5—4 × 5.5—7 × 1.2—2.2 cm; cotyledones imperfecte connatae, parte libero 3—3.7 cm profundo.

Typus: New Guinea. East. Gulf Dist.: E. Purari River delta channel, *c.* 15 miles inland from the coast, fl., *Schodde (and Craven) 4492* (L: iso in K).

Further specimens examined:

NEW GUINEA. West. Div. W. New Guinea: Inanwatan, Tisa, veg., *bb 32644* (L); Beriat, veg., *Kalkman BW 6254* (L). — Div. Fak-Fak: Boedidi R., fr. (picked up from ground), *van der Zee BW 3135* (L). — Div.

S. New Guinea: Erma, Asmat region, veg., *Nautje BW 3250* (L), *Hoogerbrugge s.n.* (L); along Digoel R., near Koeweh, veg., *Versteegh BW 4844* (L). — East. Gulf Dist.: Ti-Wu Creek, Kikori R., veg., *Hart NGF 4548* (BO, L, SING); Romilly Sawmill logging area, fl. & fr., *Hart 5032* (BM, BO, K, L, SING); near Ravikivau, Purari delta, young fl., *Craven & Schodde 809* (L). — Western Dist.: Tuidemasuk Road, Kiunga, fr., *Streimann & Lelean NGF 18316* (L). — Morobe Dist.: Cult. in Bot. Gard., Lae, fl., *Henty & Streimann NGF 38963* (L), origin from Gulf Dist.

Ecology. Seasonally inundated forests along rivers, freshwater swamps, or forests on well-drained soil; up to 10 m alt.

Notes. *Gluta papuana* is the only species of this genus so far found in New Guinea. It is closely allied to the widely distributed species *G. renghas* and vegetative specimens of these two species are quite similar. It can be distinguished from that species by the following characters: 1) torus 0.7—1.2 mm long (against 2—3 mm long), 2) petals with pinnate venation (against palmate venation), 3) drupe slightly reniform, smooth, on an obscure, excentric stalk (against drupe subglobose, with irregular crests and protuberances, on a centric, *c.* 0.5 cm long stalk), and 4) cotyledons with free part/solid part = 4—6:1 (against = 1:10 or more).

There is no information on the irritant properties of resinous sap of this tree recorded on field labels (cf. also van Royen, l.c.), but it is stated in a report by E. E. van der Zee (Verslag Bosverkenning Boedidi-Waja River, stencilled, 1956, p. 4, append. 4, & photo.). He reported that the sap of this tree (*BW 3135*, L) in contact with the skin causes to raise blisters as from unripe mangos; he also recorded that by chewing the inner bark the taste is at first sweetish, then bitter and sour, and is painful to the mucous membrane of the mouth.

11. **Gluta pubescens** (Ridl.) Ding Hou, *comb. nov.*

Melanorrhoea pubescens Ridl., Fl. Mal. Pen. 1 (1922) 530. — Type: *Derry 1010* (K), Malacca.

12. **Gluta rostrata** Ding Hou, *spec. nov.*

Arbor usque 20 m alta et 65 cm diam. *Folia* obovato-oblonga, oblanceolata, vel elliptica, 7.5—16 × 2.5—6.5 cm, basi attenuata, apice obtusa, rotundata, vel emarginata, nervis 9—14 paribus, petiolo 0.5—1.7 cm longo. *Inflorescentiae* 9.5—13.5 cm longae, puberulae, pedicelli 10—27.5 mm longi. *Calyx* basi circumscissilis, calyptriformis, 12—15 mm longus, apice rostratus, extus puberulus. *Petala* elliptico-oblonga vel elliptico-lanceolata, interdum lanceolata, 7—12 × 2.5—4 mm, in fructu non aucta, decidua, extus dense hirta. *Stamina* ∞ (ultra 100); filamenta 2.7—7 mm longa, sparsim hirta; antherae oblongae, c. 0.7 mm longae. *Torus* 1—2.5 mm longus, sparsim hirtus. *Ovarium* subglobosum, 0.5—0.7 mm diam., stylo terminali, 2.5—3.5 mm longo. *Drupa* globosa, leviter depressa, 3—4 cm diam., lenticellis densis; cotyledones liberae, 1.7—2.7 cm diam.

Typus: Sumatra. Tapanoeli: Polang, fl., *Theunissen 57* (L).

Further specimens examined:

SUMATRA. Atjeh. Singkel, fr., *bb 3166* (= *Bujung Etek 2*) (L). — Tapanoeli. Sibolga, fr., *bb 13462* (L); Mandoeamas complex, fl., *bb 28180* (K, L, SING); Sihorbo, veg., *bb 26563* (SING); Baroes, fr., *bb 29546* & *29565* (L, SING); Polang, fr., *Theunissen 58* (L). — Indragiri. Taluk region, veg., *Meijer 4125* (SING); Moeara Pedjangki, veg., *bb 27432* (L); P. Gelang, veg., *bb 29121* & *29152* (SING).

Ecology. Lowland forests and marshy places; up to 60 m alt.

Notes. The flower has a rather long pedicel (10—27.5 mm) and has more than 100 stamens which seem to be arranged more or less in whorls. Its calyptra-like calyx is

gradually narrowed upward and the apical part is prominently beak-like as the specific epithet alludes to. The slightly depressed, globose fruit is characterized by the densely lenticellate and rather hard pericarp.

The present species shows a close relationship with *G. aptera*.

13. Gluta rugulosa Ding Hou, *spec. nov.*

Arbor usque c. 30 m alta. *Folia* obovata ad oblanceolata, 6—27.5×4.5—10.5 cm, subtus leviter puberula interdum glabrescentia, basi decurrens, apice rotundata, interdum leviter emarginata, nervis 11—21 paribus, petiolo 0—1 cm longo. *Inflorescentiae* 5—14(—25) cm longae, puberulae; pedicelli 5—7 mm longi. *Calyx* basi circumscissilis, calyptriformis, 7—8 mm longus, apice breviter acuminatus, extus dense hirtus. *Petala* elliptico-oblonga vel ovato-oblonga, 7.5—9×2.7—3.2 mm, in fructu valde aucta, extus hirta. *Stamina* ∞ (c. 40); filamenta 3.5—4 mm longa, hirta; antherae oblongae, c. 1 mm longae. *Torus* 1—1.5 mm longus, sparsim hirtus. *Ovarium* late ellipsoideum, c. 1 mm longum, furfuraceum, stylo terminali, 3—4 mm longo. *Drupa* globosa, c. 3.5 cm diam., bubalina, furfuracea, rugosa; petala aliformia, elliptico-lanceolata, 2.5—3×0.2—1 cm; cotyledones liberae.

Typus: Borneo. Sarawak: Baram, fl., *Hose 41* (L; iso in BM, CGE, K).

Further specimens examined:

BORNEO. Brunei. *Sinclair & Kadim bin Tassim 10478* (SING), fr. — Sabah. Sipitang: Bt Suayo, fr., *Wood SAN 16261* (L, SING); Kuala Belait, Compartment 5, Andalau For. Res., young fr., *Wood, Smythies & Ashton SAN 17513* (L, SING). — Indon. Borneo. Kuala Kapoeas: Sg. Masolan, fl., *bb 15077* (L); Pontianak, fl., *Dumont s.n.* (L, sheet no. *920.160—519*); without precise locality, fl., *Jaheri s.n.* (L, sheet no. *920.260—505*).

Ecology. In lowland forests or forest-edges; up to 150 m alt.

Note. The present species resembles *G. speciosa*, but differs from it by the sessile or subsessile leaves, glabrous ovary, and wrinkled fruit with much enlarged, wing-like petals.

14. Gluta sabahana Ding Hou, *spec. nov.*

Arbor usque 30 m alta et 60 cm diam. *Folia* ut videtur verticillatim aggregata, oblanceolata, obovato-oblonga, elliptico-lanceolata, vel anguste elliptica, 13—23×3—8.5 cm, basi cuneata vel decursiva, apice acuminata vel acuta, nervis 9—15 paribus, petiolo plerumque brevissimo, 0.2—0.7 cm longo. *Inflorescentiae* 7—15 cm longae, puberulae; pedicelli 3—6 mm longi. *Calyx* irregulariter ruptus, spathaceus, 4—5.5 mm longus, extus puberulus. *Petala* oblanceolata, 5—7.5×1—1.2 mm, in fructu non aucta, decidua, extus puberula. *Gynandrophorum* 1—1.2 mm longum. *Stamina* 5(—7), 5—6 mm longa; antherae oblongae, 1—1.2 mm longae. *Ovarium* obovoideum, 1—1.5 mm longum, puberulum, stylo excentrico, 3—4 mm longo. *Drupa* oblique late ellipsoidea, 7—9×5—6.5×3.5—5 cm, furfuracea; embryo fere semiorbiculatus, planus, 3—4.5×5 cm, cotyledones imperfecte connatae, parte libero c. 1 cm profundo.

Typus: Borneo. Sabah: Tawau, mile 25, Garson Rd, fl., *Sinanggul SAN 40615* (L).

Further specimens examined:

BORNEO, Sabah. Dist. Tawau: Elphinstone, fr., *Elmer 21416* (BO, SING); Bombalai, young fr., *Aban Gibot SAN 18607* (L); Membalua For. Res., fl., *Singh SAN 22790* (BO, SING); Baradaya For. Res., fl., *Singh & Aban SAN 30060* (L) and *Singh & Nordin SAN 48755* (K, L); Maria Rd, fl., *Singh SAN 30106* (L), fl. & young fr., *Aban Gibot SAN 30575* (K, L); Merotai Besar, fl., *Aban Gibot SAN 31326* (L); Brantian,

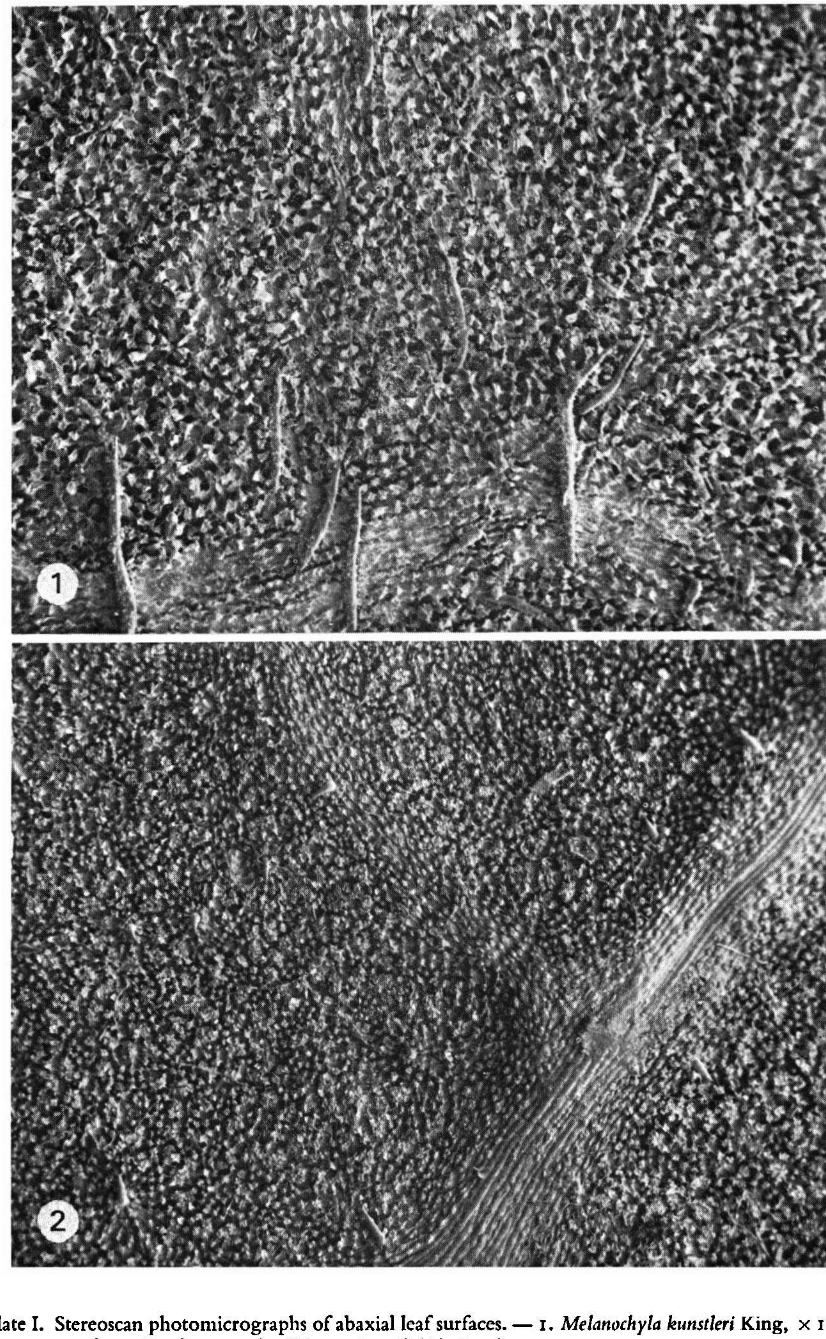


Plate I. Stereoscan photomicrographs of abaxial leaf surfaces. — 1. *Melanochyla kunstleri* King, × 105. — 2. *Semecarpus glaucus* Engl., × 90. (1. *SF 37128*; 2. *SAN 28100*).

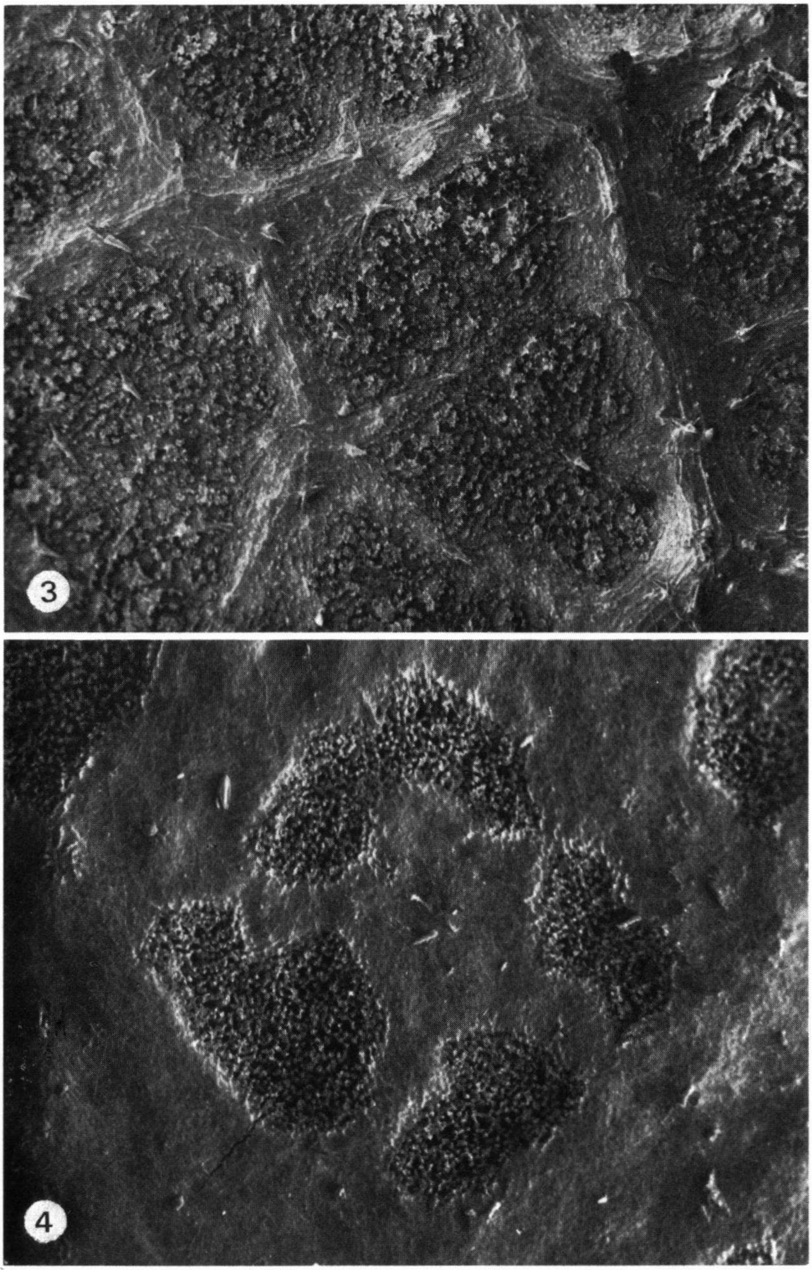


Plate II. Stereoscan photomicrographs of abaxial leaf surfaces. — 3. *Semecarpus cassuvium* Roxb., × 90. — 4. *Melanochyla borneënsis* (Ridl.) Ding Hou, × 50. (3. *Kostermans 7803*; 4. *Beccari PB 241*).

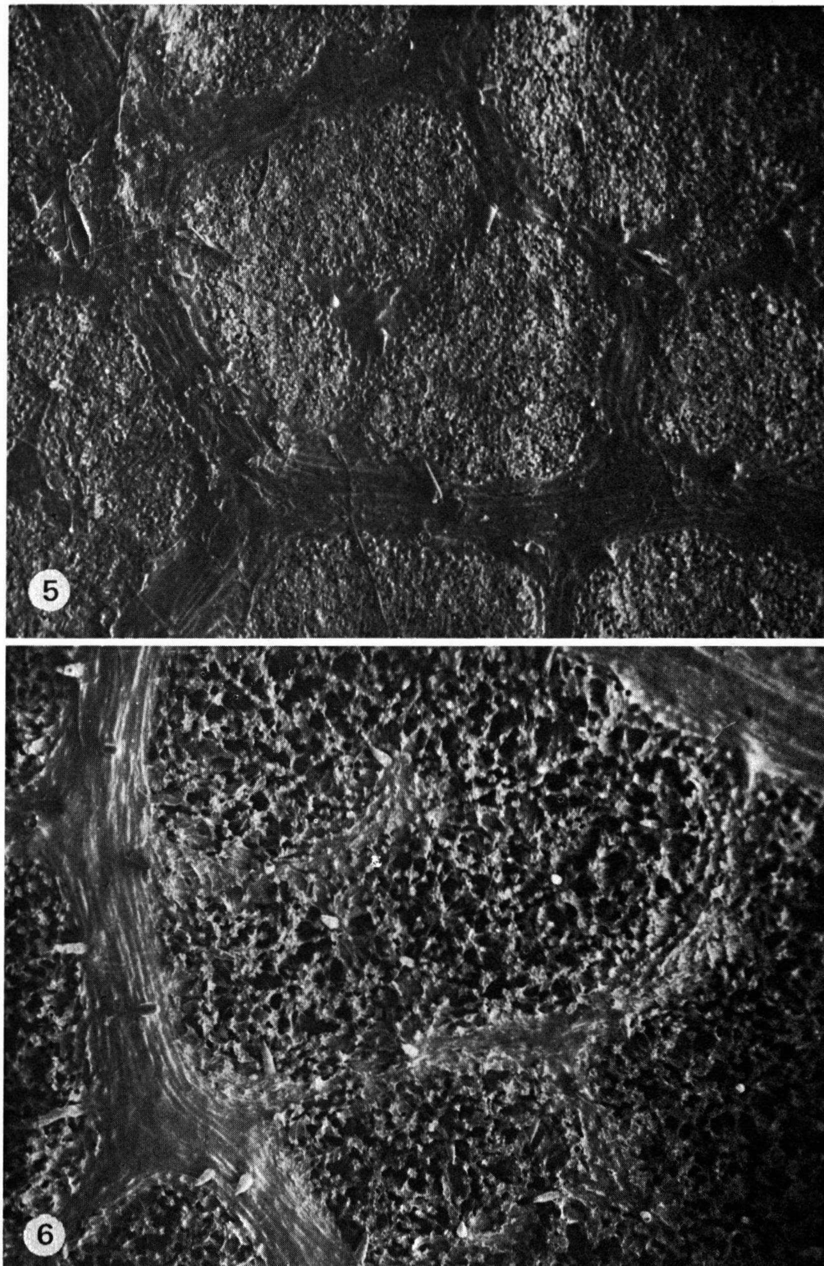


Plate III. Stereoscan photomicrographs of abaxial leaf surfaces. — 5. *Semecarpus trachyphyllus* Perkins, × 105. — 6. *S. bracteatus* Lauterb., × 95. (5. *PNH 42090*; 6. *Brass & Versteeg 12590*).

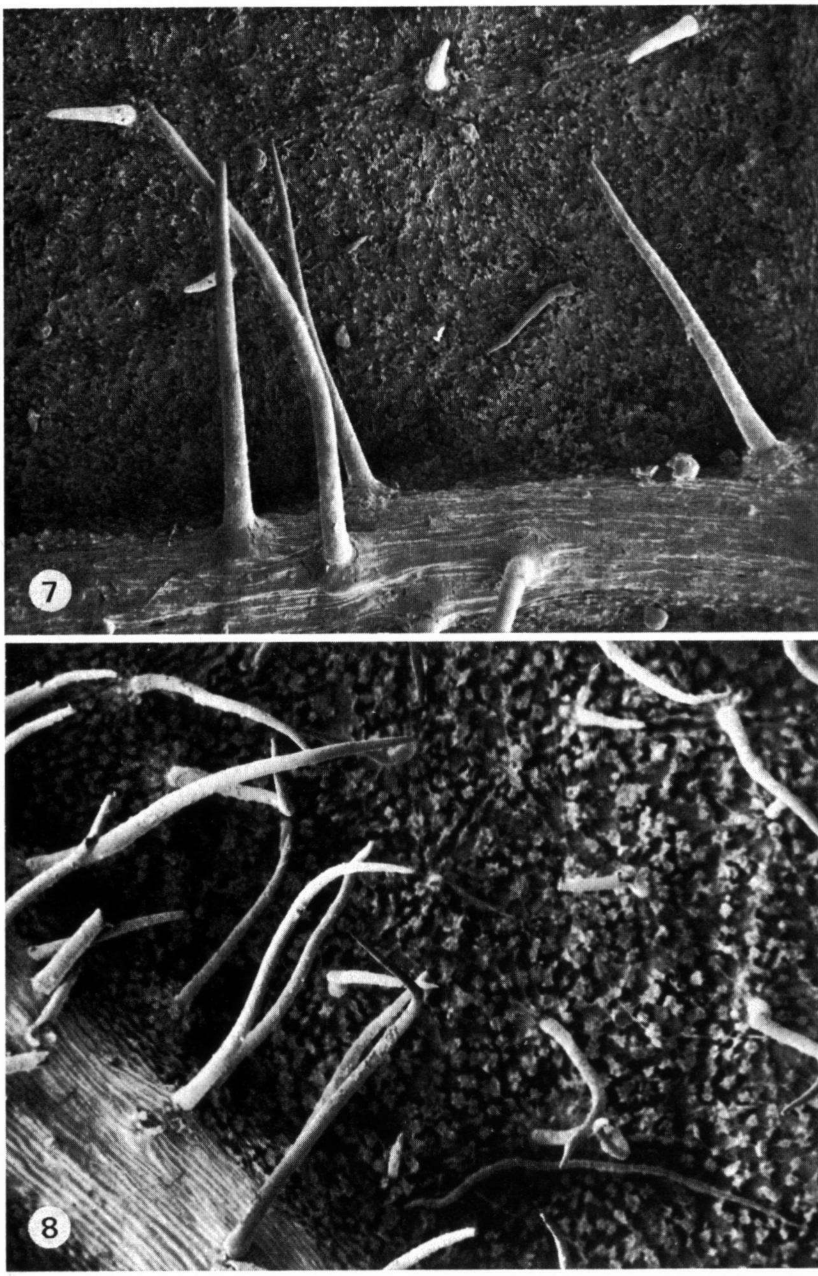


Plate IV. Stereoscan photomicrographs of abaxial leaf surfaces. — 7. *Semecarpus aruensis* Engl., × 90. — 8. *S. bunburyanus* Gibbs, × 90. (7. *Brass 7271*; 8. *Ding Hou 311*).

young fr., *Bongsu SAN 63078* (L). — Dist. Mostyn: mile 38, Kunak Rd, young fr., *Ahmad Talip SAN 65855* (L). — Dist. Kinabatangan: Tedong, young fr., *Singh SAN 31085* (L). — Dist. Sandakan, Sepilok For. Res.: veg., *Keith A 15* (SING); fr., *Sinclair et al. 9339* (L, SING); fr., *Sam SAN 19696a* (L); fl., *Nicholson & Charington SAN 21153* (L); fl., *Charington SAN 29853* (NT 453) (BO, L); fr., *Brand SAN 30972* (L); young fr., *Sam SAN 63507* (L); fl., *Aban & Sam SAN 73663* (L); young fr., Hujong Tanjon, *Aban & Sam SAN 75399* (L).

E c o l o g y. In lowland forests, sometimes occurring in swamp forests; up to 90 m alt.

N o t e s. *Gluta sabahana* can be distinguished from other species by a combination of the following characters: 1) leaves usually subsessile and seemingly in whorls; 2) flowers with rather long pedicels (3—6 mm); 3) stamens 5; 4) ovary puberulous; 5) fruits rather big, brownish, broadly ellipsoid (7—9 × 5—6.5 × 3.5—5 cm), bent obliquely or horizontally; and particularly by 6) cotyledons almost united into one and free only on one side (*c.* 1 cm deep). Its closer relationship is with *G. laxiflora* and *G. torquata.*

Vegetative specimens of the present species are similar to those of *G. velutina* and are very difficult to identify with certainty. In such cases good field notes on habitat and habit of the plant would be helpful. The present species is a rather tall tree up to 30 m high, which occurs in lowland forest, sometimes in swamp forest, up to 90 m alt., while *G. velutina* is a large shrub or small tree up to 10 m high which is usually found in mangrove swamps and tidal waterways, at a few m altitude. In fertile state specimens of these two species can be easily identified.

15. **Gluta speciosa** (Ridl.) Ding Hou, *comb. nov.*

Melanorrhoea speciosa Ridl., Kew Bull. (1933) 197. — T y p e: *Haviland 3147* (K; iso in L, SING), Sarawak.

16. **Gluta usitata** (Wall.) Ding Hou, *comb. nov.*

Melanorrhoea usitata Wall., Pl. As. Rar. 1 (1829) 9, t. 11 & 12; Hook. *f.*, Fl. Brit. Ind. 2 (1876) 25; Kurz, Fl. Burm. 1 (1877) 318; Engl. in DC., Mon. Phan. 4 (1883) 237, t. 5, f. 1—5; Pierre, Fl. Coch. (1897) t. 367 B; Tard., Fl. C. L. & V. 2 (1962) 103. — T y p e: *Wallich Cat. 597* (K; iso in L), Martaban, Burma.

17. **Gluta wallichii** (Hook. *f.*) Ding Hou, *comb. nov.*

Stagmaria verniciflua auct. non Jack: Wall., List (1829) no. 980.

Melanorrhoea wallichii Hook. *f.*, Fl. Brit. Ind. 2 (1876) 25. — L e c t o t y p e: *Wallich Cat. 980* (K), Singapore; s y n t y p e: *Maingay 482* (K), Malacca.

Melanorrhoea maingayi Hook. *f.*, l.c. — T y p e: *Maingay 485* (K; iso in CGE, L), Malacca.

Swintonia obtusifolia Engl. in DC., Mon. Phan. 4 (1883) 231. — T y p e: *Beccari PB 2898* (K), Borneo.

Melanorrhoea woodsiana Scortech. *ex* King, J. As. Soc. Beng. 65, ii (1896) 485. — S y n t y p e s: *Scortechini 2086* (not seen), *King's Coll. 7788* (K, SING), Perak.

Swintonia elmeri Merr., Pl. Elm. (1929) 167. — T y p e: *Elmer 21603* (BM, K, L, S, SING), Tawau, N. Borneo.

MANGIFERA

According to Mukherjee ('Mukherji') (Lloydia 12, 1949: 78, tab. 1; J. Linn. Soc. Bot. 55, 1953: 66—68, map 1, tab. 1—3; Econ. Bot. 26, 1972: 260—264, tab. 1, f. 1) the genus *Mangifera* is distributed in India, Ceylon, Burma, Thailand, Indochina, the Himalayan region, China (Yunnan), and throughout Malesia as far as New Guinea in the east.

However, it is evident that wild mango plants occur also in the Solomon Islands: Walker (For. Brit. Solomon Isl. Protect., 1948: 92) reported the occurrence of *M. salomonensis* C. T. White (= *M. altissima* Blanco) in the inland primary rain forest, only encountered 'in one locality on the North Coast of Guadalcanal, in the Tenaru area, where

there may be as many as 20 large trees...'. On the field label of a duplicate of the type, *Walker & White BSIP 18* (L), the tree was recorded as 54 m high, the tallest one ever reported in this genus.

I have reduced it to *M. altissima*, which is widely distributed in East Malesia and also occurs in New Britain. From Guadalcanal two collections are known and there is no reason to suspect it to be introduced.

SUBDIVISION OF THE GENUS

The genus *Mangifera* has been divided into sections by several botanists. Its subdivisions have not been fully reviewed and some of the sections have not been typified. Therefore a concise historical review and typification of the sections are presented here.

Hooker *f.* (in Benth. & Hook. *f.*, Gen. Pl. 1, 1862: 420) was the first to divide the genus into two sections based on the characters of the disk and its relation to the petals and stamens. He did not propose names for the sections but gave a representative species to each of them.

In 1869, Marchand (Rév. Anacard. 104—105, 188—189), in addition to the two sections of Hooker *f.*, added a new one. He described the floral characters of these three sections and proposed a name together with a type species for each of them:

Sect. I. *Limus* March. — 'Disk stipiform, petals and stamens connate with the torus, ovary slightly raised. Related to the genus *Gluta*'. Monotypic: *M. foetida* Lour.

Sect. II. *Manga* March. — 'Disk margin connate with the stamens'. Monotypic: *M. leschenaultii* March. (= *M. foetida*).

Sect. III. *Amba* March. — 'Disk lobed, glandular, staminodes alternate with stamens. Section connecting *Anacardium* with *Mangifera*'. Consisting of nine species. Type species: *M. indica* Linn.

In 1876, Hooker *f.* (Fl. Brit. Ind. 2: 13—20) maintained his own two sections but still kept them unnamed. He did not mention or cite Marchand's sections and slightly modified the characters as given earlier by himself for his sections.

'Sect. 1. Disk tumid, usually 5-lobed, broader than the ovary. Petals free from the disk, inserted at its base'. It is similar to the Sect. *Amba* March. and consists of *M. indica* and twelve other species.

'Sect. 2. Disk narrow, often reduced to the form of a stalk to the ovary, rarely obsolete in the ♂ fl.'. It covers the Sect. *Limus* and *Manga* of Marchand, and consists of *M. foetida*, *M. odorata* Griff., and five other species.

Engler (in DC., Mon. Phan. 4, 1883: 197, 198 & 210) stated that natural series as recognized by Hooker *f.* exist in the genus *Mangifera*. He also divided this genus into two groups, A & B, which coincide with the sections of Hooker *f.* He did not indicate their ranks, a practice which he used for many genera in his monograph of the *Anacardiaceae*. He cited Sect. *Amba* March. under group A but did not mention Marchand's other sections for his group B. From the species included, e.g. *M. foetida* & *M. odorata*, it is evident that the Group B covers Marchand's Sect. *Limus* and *Manga*.

In 1897 Pierre (Fl. Coch., sub Explic. t. 364 & 365) studied the then known species of *Mangifera* and divided the genus into 5 sections based on flowering characters: the number of stamens, the attachment of stamens to the disk, and the style, viz.:

Sect. I. *Euantherae* Pierre — 'Disk short and thick. Stamens 5—12, of which 5 or 6 fertile, the others reduced to filaments'. Consisting of *M. duperreana* Pierre, *M. pentandra* Hook. *f.*, *M. lagenifera* Griff., and two other species.

Sect. II. *Amba* March. — Consisting of *M. indica* L., *M. quadrifida* Jack, *M. macrocarpa* Bl., *M. microphylla* Griff., and ten others.

Sect. III. *Eudiscus* Pierre — 'Disk or receptacle ± developed. Stamens 5, all developed, unequal and ± fertile'. Consisting of *M. foetida* and *M. supera* Hook. *f.*

Sect. IV. *Microdiscus* Pierre — 'Disk short and hardly lobed. 1 stamen fertile, the others reduced to short filaments'. Monotypic: *M. caesia* Jack.

Sect. V. (sect. or new genus) *Marchandora* Pierre — 'Cotyledons [seeds] reniform, laterally attached, ruminated by the second integument [i.e. inner integument penetrating the multilobed or -folded cotyledons], the latter phenomenon lacking in *Mangifera*. Secretory canals absent around the pith'. Monotypic: *M. camptosperma* Pierre.

Pierre adopted only one of Marchand's three sections, i.e. Sect. *Amba*, and did not mention or cite his two others. As already pointed out by Mukherji (Lloydia, 12, 1949: 75) 'these sections are apparently inadequate because of the great variation in the disk even among closely allied species'. The first four sections, according to the characters described and the species included, could be easily grouped into two groups similar to those of Hooker *f.*: Sect. I+II and Sect. III+IV.

The 'ruminated cotyledons' (=labyrinthine seed) described from *M. camptosperma* of Pierre's Sect. V has now been found also to occur in two Malesian species, *M. gedebe* Miq. and *M. inocarpoides* Merr. & Perry (cf. van Heel, Blumea 19, 1971: 109). The flowering characters of these three species match those of Sect. I of Hooker *f.* or Sect. *Amba* March.

Mukherji (l.c.) in his monograph accepted the two sections described by Hooker *f.* (1876, l.c.) but did not mention his earlier treatment (1862, l.c.). He did not consider the nomenclature for subdivisions and also did not adopt a name for each of the sections treated in his paper.

After having studied the genus, it is appropriate to subdivide the genus into two sections in the sense of Hooker *f.* The correct name of each section and its synonyms are treated as follows.

Mangifera L., Gen. Pl. ed. 5 (1754) no. 276; Sp. Pl. 1 (1753) 200; Hook. *f.* in Benth. & Hook. *f.*, Gen. Pl. 1 (1862) 420; March., Rév. Anacard. (1869) 102 & 188; Hook. *f.*, Fl. Brit. Ind. 2 (1876) 13; Engl. in DC., Mon. Phan. 4 (1883) 195; Pierre, Fl. Coch. (1897) sub Expl. t. 364 & 365; Corner, Ways. Trees 1 (1940) 106; Mukherji, Lloydia 12 (1949) 77. — Type: *M. indica* L.

Sect. 1. Mangifera

Sect. *Mangifera* — Sect. 1 Hook. *f.* in Benth. & Hook. *f.*, Gen. Pl. 1 (1862) 420; Fl. Brit. Ind. 2 (1876) 13; Mukherji, Lloydia 12 (1949) 78. — Sect. *Amba* March., Rév. Anacard. (1869) 104 & 189; Pierre, Fl. Coch. (1897) sub Expl. t. 364 & 365. — Group A Engl. in DC., Mon. Phan. 4 (1883) 198. — Type: *M. indica* L.

Sect. *Euantherae* Pierre, l.c. — Lectotype: *M. duperreana* Pierre.

Sect. *Marchandora* Pierre, l.c. — Type: *M. camptosperma* Pierre.

Disk short-cupular, rarely pulvinate and concave above, usually 4- or 5-lobed, papillose, completely or partly surrounding the ovary. *Stamens* with filaments free.

Representatives (*indicating Malesian species or distributed also in Malesia): **M. altissima* Blanco, *M. andamanica* King, *M. caloneura* Kurz, *M. camptosperma* Pierre, *M. cochinchinensis* Pierre, *M. duperreana* Pierre, *M. flava* Evrard, **M. gedebe* Miq., **M. griffithii* Hook. *f.*, **M. havilandii* Ridl., **M. indica* L., **M. inocarpoides* Merr. & Perry, **M. longipes* Griff., **M. minor* Bl., **M. parvifolia* Boerl. & Koord., **M. pentandra* Hook. *f.*, **M. quadrifida* Jack, *M. reba* Pierre, *M. siamensis* Warb. *ex* Craib, **M. similis* Bl., *M. sylvatica* Roxb., **M. timorensis* Bl., *M. zeylanica* Hook. *f.*

Sect. 2. **Limus**

Sect. *Limus* March., Rév. Anacard. (1869) 104 & 188. — Sect. 2 Hook. *f.* in Benth. & Hook. *f.*, Gen. Pl. 1 (1862) 420; Hook. *f.*, Fl. Brit. Ind. 2 (1876) 17; Mukherji, Lloydia 12 (1949) 80. — Group B Engl. in DC., Mon. Phan. 4 (1883) 210. — Type: *M. foetida* Lour.
Sect. *Manga* March., l.c. — Type: *M. leschenaultii* March. (= *M. foetida*).
Sect. *Eudiscus* Pierre, l.c. — Lectotype: *M. superba* Hook *f.*
Sect. *Microdiscus* Pierre, l.c. — Type: *M. caesia* Jack.

Disk pulvinate, rarely cylindric and torus-like, often reduced and stipe-like at the base of ovary in bisexual flowers, usually not lobed, not papillose, rarely obsolete in the ♂ flowers. *Stamens* with filaments often connate at the base, or sometimes free.

Representatives (all occurring in Malesia; ** indicating distributed also outside Malesia): *M. caesia* Jack, *M. decandra* Ding Hou, ***M. foetida* Lour., *M. gracilipes* Hook. *f.*, *M. lagenifera* Griff., ***M. macrocarpa* Bl., *M. monandra* Merr., *M. odorata* Griff., *M. pajang* Kosterm., *M. superba* Hook. *f.*

The flowers of *M. minutifolia* Evrard, S. Vietnam, are not known; hence, this species cannot be placed in a section.

NOTES ON SPECIES

1. **Mangifera altissima** Blanco

M. altissima Blanco, Fl. Filip., ed. 1 (1837) 181; Merr., Sp. Blanc. (1918) 232. — Type: Blanco's description.
M. mucronulata Bl., Mus. Bot. Lugd.-Bat. 1 (1850) 201. — Type: *Zippelius s.n.* (L, sheet no. *897.363—560*), W. New Guinea.
M. parvifolia Merr., Philip. J. Sc. 20 (1922) 401, *nom. illeg.*, *non* Boerlage & Koorders, 1910. — *M. merrillii* Mukherji, Lloydia 12 (1949) 104, f. 11. — Type: *Maneja & Bawan FB 27169* (iso in BM), Luzon.
M. salomonensis C. T. White [*ex* Walker, For. Brit. Solomon Isl. Protect. (1948) 92, *sine descr. latine*] J. Arn. Arb. 31 (1950) 95. — Type: *Walker & White BSIP 18* (iso in L), Quadalcanal, Solomon Is.

Merrill's (1918) interpretation of *M. altissima* is evidently correct. His illustrative specimen is: *Merr. Sp. Blanc. no. 831* (BO, L) from Luzon.

The type of *M. mucronulata* consists of two twigs with prominent flower buds and young flowers. Its characteristic angular twigs and elliptic or elliptic-oblong leaves are rather easy to recognize.

The type of *M. parvifolia* Merr. has flowering branchlets with rather small leaves (5—10 × 2—3 cm), puberulous inflorescences, and young flowers. It is similar to some collections of *M. altissima* in flower also from Luzon at more or less the same stage of development, e.g. *FB 356* & *485* (BO, SING). It is evident that these two species are conspecific.

2. **Mangifera caesia** Jack

M. caesia Jack in Roxb., Fl. Ind. 2 (1824) 441, *ex descript.*; Merr., En. Philip. 2 (1923) 468; Kosterm., Reinwardtia 7 (1965) 19, *quoad* var. *caesia*. — Type: *Jack s.n.* (not seen), Sumatra.
M. kemanga Bl., Mus. Bot. Lugd.-Bat. 1 (1850) 202. — *M. caesia* var. *kemanga* Kosterm., op. cit. 20. — Lectotype: *Hasskarl 23* (L, sheet no. *897.363—389*), Java.
M. polycarpa Griff., Notul. 4 (1854) 416, t. 167, f. 2. — Type: *Griffith Cat. no. 1097* (K), Malacca.
M. verticillata C. B. Rob., Philip. J. Sci. 6 (1911) Bot. 337. — Type: *Elmer 13258* (iso in BM, BO, L), Mindanao.
M. caesia var. *wanji* Kosterm., l.c. — Type: *Kostermans s.n.* (BO), Borneo.

Griffith (l.c.) described the species *M. polycarpa* based on fruiting material. While preparing the description of *M. caesia*, he had only flowering material. Because of some slight differences in leaves, he placed the flowering and fruiting material into two different species.

In *M. caesia*, one may find that a flowering branch sometimes has seemingly verticillate leaves and a vegetative or old branch usually has spiral ones. The isotype of *M. verticillata*, in the Rijksherbarium, Leiden, consists of one flowering twig. The leaves are seemingly verticillate only at the apical end and spiral on the rest of the twig. Merrill (l.c.) already reduced *M. verticillata* to *M. caesia*.

In the present species, Kostermans (l.c.) recognized three varieties, i.e. var. *caesia*, var. *kemanga* (Bl.) Kosterm., and var. *wanji* Kosterm. He stated that 'the inflorescence of the wild form of *M. caesia* is more condensed than that of the cultivated varieties; its fruit is very acid; ...'. He also added that 'the two varieties *kemanga* and *wanji* differ only by the more elongated and open inflorescences and by the fruits, which are sweet-acid and agreeable in taste...'. According to him, *M. kemanga* Bl. 'has pear-shaped fruits that are pale brown in colour and dull, whereas the variety *wanji* has fruits of the same shape, same texture and same taste, but they are glossy greenish white with partly a red coloration'. However, in the original description of *M. kemanga*, the fruit was clearly described as 'green outside' ('*Fructus extus virides*'). It appears that the fruits of var. *kemanga* and var. *wanji* are similar to each other.

According to Wester (Bull. Bur. Agr. Philip. 18, 1920: 14), all attempts to graft *M. caesia* on *M. indica* at an experimental station in the Philippines have failed, 'showing that the physiological affinity between the two species is rather remote'.

3. **Mangifera griffithii** Hook. *f.*

M. griffithii Hook. *f.*, Trans. Linn. Soc. 23 (1860) 168, in note; Fl. Brit. Ind. 2 (1876) 14; Pierre, Fl. Coch. (1897) t. 364 K. — Type: *Griffith 1100/1* (K; iso in L), Malacca.
M. sclerophylla Hook. *f.*, Fl. Brit. Ind. 2 (1876) 15. — Type: *Maingay 494* (K), Malacca.
M. microphylla Griff. *ex* Hook. *f.*, Fl. Brit. Ind. 2 (1876) 17; Pierre, op. cit. 364 L. — Type: *Griffith 1103* (K), Malacca.
M. beccarii Ridl., Kew Bull. (1933) 194. — Type: *Beccari PB 3079* (K), Sarawak.

The present species and the three others reduced above were mainly based on leaf characters. When authentic material and additional collections were examined, they appeared similar to one another not only in vegetative characters but also in inflorescences and flowers.

Pierre (l.c.) already stated that *M. microphylla* and *griffithii* are hardly distinct from each other. Ridley (l.c.) also pointed out that his *M. beccarii* is closely related to *M. griffithii* and differs chiefly by leaf characters.

Corner made several very well prepared collections which he named *M. microphylla*. Each of them consists of three or four sheets, collected from various parts of a single tree, showing the variation in leaf size and texture. For example, *SF 34951* (SING), in fruit, was collected from Singapore on July 12, 1938, consisting of four sheets. The large leaves from lower branches have the largest blade 23 by 9 cm with a petiole of 6.5 cm, while the small ones from upper branches have the blade *c.* 7 by 4 cm with petioles of *c.* 0.8 cm.

4. **Mangifera inocarpoides** Merr. & Perry

M. inocarpoides Merr. & Perry, J. Arn. Arb. 22 (1941) 532. — Type: *Brass 8462* (iso in BO, L), New Guinea.
M. indica auct. non L.: Lauterb., Nova Guinea 8, 1 (1910) 297, based on *Branderhorst 111* (L).

The present species was based on a fruiting collection from Papua, Western Dist., Penzara, between Morehead and Wassi Kussa Rivers. It was recorded as 'abundant in rain-forest along creeks' and is apparently growing wild there.

In the New Guinea material of *Mangifera*, fortunately, two fertile collections were found, which were collected not far from the type locality and match the type very well. It is evident that they all belong to one distinct species. One of the collections is a very well prepared flowering specimen, *Anta 111* (BO, L), collected from Djalan bivouac, Pomboa, along Merauke River, July 16, 1941 (cf. Fl. Mal. I, 1, 1950: 22a); another one is *Branderhorst 111* (L), with two young fruits, collected from Okaba and vicinity, Oct. 1, 1907 (cf. Fl. Mal. I, 1, 1950; 75a).

5. Mangifera lagenifera Griff.

Perkins (Fragm. Fl. Philip. 1904: 25) erroneously recorded *M. lagenifera* Griff. for the Philippine flora, as already correctly pointed out by Merrill & Rolfe (Philip. J. Sc. 3, 1908: Bot. 108). The two specimens cited were: *Cuming 2330* (actually from Malacca, Malay Peninsula) and *Merrill 610* (=*Buchanania arborescens*) from Culion I., Philippines.

6. Mangifera macrocarpa Bl.

M. macrocarpa Bl., Bijdr. (1826—27) 1158; Mus. Bot. Lugd.-Bat. 1 (1850) 201; Engl. in DC., Mon. Phan. 4 (1883) 210; K. & V., Bijdr. 4 (1896) 87; Pierre, Fl. Coch. (1897) t. 364 D. — Lectotype: *Blume s.n.* (L, sheet no. *897.363—552*; iso in BO), Java.
M. fragrans Maingay *ex* Hook. *f.*, Fl. Brit. Ind. 2 (1876) 18. — Type: *Maingay 473* (K), Malacca.

M. macrocarpa can be easily recognized by its chartaceous, linear, linear-lanceolate, rarely spatulate leaves, with a leaf-index more than (7—)10. All the twenty-three collections which I have examined are in sterile state except two of them, viz. *Maingay 473* (K), in fl. (♂), from Malacca, and *SAN 31997a* (BO, L) with young fruits picked up from the ground, from Sabah.

The fruit was described by Blume (1850, l.c.) as of the size of a child's head. Hooker *f.* (l.c.), quoted from Maingay, recorded only the shape of the drupe in the description of *M. fragrans* as 'obliquely broadly oblong-globose'. Engler (l.c.), based on Maingay's drawing in Kew, recorded its size as 10 cm in diameter. Although its shape and size have been mentioned often in literature and sometimes on specimens, so far, I have seen only small, young, detached fruits (5.2 × 2.7 cm) on the collection from Sabah mentioned above.

Dr Kostermans in a letter addressed to Prof. Dr. van Steenis, dated March 10, 1965, stated that the trees of this species are sporadic in east Borneo but in ten year's time he did not see any of them in flower or fruit, and that the cultivated tree in Bogor has never flowered (cf. also K. & V., l.c.).

Pierre (l.c.) recorded this species for Cambodia; however, Tardieu-Blot (Fl. C. L. & V. 2, 1962: 85) stated that no specimen of it could be found in the Herbarium at Paris.

7. Mangifera odorata Griff.

M. odorata Griff., Notul. 4 (1854) 417; Hook. *f.*, Fl. Brit. Ind. 2 (1876) 17; Pierre, Fl. Coch. (1897) t. 365 B, *pro* var. *odorata* (Griff.) Pierre. — Type: *Griffith 1098* (K), Malaya.
M. foetida Lour. var. *mollis* Bl., Mus. Bot. Lugd.-Bat. 1 (1850) 199. — Type: *Blume s.n.* (L, sheet no. *897.363—417*), cult. in Java.
M. foetida Lour. var. *kawini* Bl., l.c.; Pierre, Fl. Coch. (1897) t. 365 E (as 365 F). — Lectotype: *Blume s.n.* (L, sheet no. *897.363—416*), Java.

M. foetida Lour. var. *bombom* Bl., l.c. — Lectotype: *Blume s.n.* (L, sheet no. *897.363—409*), cult. in Java.
M. oblongifolia Hook. *f.*, Fl. Brit. Ind. 2 (1876) 16. — Lectotype: *Griffith 1101* (K; iso in L), fl., Malacca; syntype: *Maingay 470* (K), fr., Malacca.

M. odorata is probably of hybrid origin: *M. foetida* × *M. indica*. It is very variable and apparently includes many forms of a hybrid swarm. There are different opinions regarding the number and status of taxa in this group. For reference, I will give some examples in the following.

In 1850, Blume (l.c.), chiefly based on characters of leaves and fruits, described four varieties under *M. foetida* Lour.: three of them being reduced to *M. odorata* here and another one, var. *sphaeroidea*, to *M. foetida*. He remarked that these varieties are intermediate between *M. foetida* and *M. indica* and that they can be placed under either one of these two species.

A few years later, Griffith (l.c.) published a new species, *M. odorata*, from Malacca. He described it in detail, especially the fruit and seed, stating that it is closely allied to *M. indica* and *M. foetida* and 'the best remarks of distinction are perhaps drawn from the fruit and the seed'. The authentic material might have been collected from a cultivated tree.

Miquel annotated the type of *M. odorata* as '*M. foetida var.* δ' [=var. *kawini* Bl.] (cf. Miq., Fl. Ind. Bat. 1, 1859: 632; Hook. *f.*, l.c.). He might be the first to recognize that this species and *M. foetida* var. *kawini* Bl. are conspecific.

In 1876, Hooker *f.* maintained *M. odorata* as a distinct species. At the same time he also described a new one, *M. oblongifolia*, which has leaves rather similar to those of *M. foetida*, but floral characters matching those of *M. odorata*.

Since then *M. odorata* was reduced to a variety under *M. foetida* by Pierre (l.c.) but was treated as a distinct species by other botanists.

As far as the authentic material and some additional collections are concerned, *M. odorata* can be distinguished from both *M. foetida* and *M. indica*. However, there are also specimens, especially sterile ones collected from cultivated trees, which sometimes can hardly be separated from either one of these two species.

M. odorata is treated here as a polymorphic species. As I already mentioned above, this species is probably of hybrid origin. In order to confirm or disprove this, further field studies on variation as well as experimental crossings are required.

Wester (Bull. Bur. Agr. Philip. 18, 1920: 15, t. 4b) reported that *M. odorata* 'has been budded on the mango, on which it makes a very satisfactory growth'.

8. **Mangifera pajang** Kosterm.

M. pajang Kosterm., Reinwardtia 7 (1965) 20, f. 1a & 1b. — Type: *Kostermans 12534* (BO; iso in L), W. Kutei.

M. pajang has been found wild as well as in cultivation in villages. It is closely related to *M. foetida* and looks as if it could be no more than a cultivar of the latter. Dried collections of these two species can hardly be determined with certainty; however, they can be easily distinguished in fresh state, especially by the fruit.

The fruits of *M. pajang* are broadly ovoid or globose, brownish, roughish, while those of *M. foetida* are obliquely ovoid, yellowish or greyish green, smooth. The brownish and roughish fruits occur so far known only in *M. pajang* and *M. caesia*.

The ripe fruit was recorded up to 15 (or more) cm ⌀. Its thick (*c.* 10 mm) rind can be peeled off, like that of a banana (cf. Kostermans, l.c.).

One collection, *Jacobs 5217* (L), from Kapit Dist., Sarawak, has a well prepared and dried piece (*c.* 1.5 cm thick) of a median, longitudinal section of a fruit (12.5 × 8 cm). There are useful field data and interesting information recorded on the label: 'fruits fully grown but not yet quite ripe, dull brown. Vern. *embàng*, Kayan. Use: The fruit is much wanted. All such trees in the forest have their owner, and the only way I could get it was by promising the coolies that I should pay afterwards 5 dollars to the owner. Thus having purchased the tree on the spot, I had it cut down instantly'.

9. Mangifera parvifolia Boerl. & Koord.

M.? parvifolia Boerl. & Koord. in Koord.-Schum., Syst. 2 (1910) 31; Mukherji, Lloydia 12 (1949) 130. — Type: *Koorders 21218* (BO), Central Sumatra: Sg. Buwatan.

M. parvifolia was based on a poor sterile specimen. When Boerlage and Koorders described this species, they were not certain about its generic identity, so a question mark was placed after the generic name. The leaves on the type resemble those of *Bouea* except for the phyllotaxy as already pointed out by them. It was placed in the '*species dubiae*' by Mukherji (l.c.) in his monograph of *Mangifera*.

In the course of the study of this genus, I was fortunate to find among the material from Sumatra several sterile collections (e.g. *bb. 5790, 10361, 17550, 29310*, BO) and two fertile ones: *Beguin 485* (BO), in fr., and *Bruinier 222* (BO), in fl., which match the type very well. It is evident that the present species is a distinct one, characterized by the rather small, subcoriaceous, *Bouea*-like leaves and axillary puberulous panicles which often occur in several successive leaf-axils.

There are two collections, *Corner SF 26193* (SING), in fl., from Singapore, and *bb 28489* (BO), sterile, from Indragiri, Sumatra, which are similar to the specimens of the present species except that the leaf apex is obtuse or acute (not acuminate). They may belong to this species or even to a new one. In order to ascertain the identification, fruiting material is needed.

The present species is allied to *M. griffithii* from the Malay Peninsula and *M. havilandii* from Borneo especially in vegetative characters, and sterile specimens of these three species are very difficult to determine with certainty.

10. Mangifera pentandra Hook. *f.*

M. pentandra Hook. *f.*, Fl. Brit. Ind. 2 (1876) 14; Corner, Ways. Trees 1 (1940) 111; Mukherji, Lloydia 12 (1949) 81. — Lectotype: *Maingay 471* (K), Malacca; syntype: *Griffith 1095* (K), Malacca.
M. lanceolata Ridl., J. Str. Br. R. As. Soc. 59 (1911) 90. — Type: *Ridley 15233* (K), Kedah.

M. pentandra and *M. lanceolata* have hitherto been treated as two distinct species on the ground that the five stamens are all fertile in the former while there are three of them fertile in the latter (cf. Mukherji, l.c.). However, the specimens of these two species are similar to each other and the number of fertile stamens varies from 3 to 5 (cf. Corner, l.c.). They are evidently conspecific.

11. Mangifera quadrifida Jack

M. quadrifida Jack in Roxb., Fl. Ind. 2 (1824) 440. — Type: *Wallich Cat. 8489* (K-W, Coll. *Jack*), Penang.
M. rigida Bl., Mus. Bot. Lugd.-Bat. 1 (1850) 200. — Lectotype: *Korthals s.n.* (L, sheet no. *897.363—565*; iso in BO), Sumatra.
M. spathulaefolia Bl., l.c. — *M. quadrifida* var. *spathulaefolia* (Bl.) Engl. in DC., Mon. Phan. 4 (1883) 207. — Lectotype: *Korthals s.n.* (L. sheet no. *897.363—576*), Bengowiran, Borneo.
M. langong Miq., Sum. (1861) 521. — Type: *Diepenhorst HB 2333* (U; iso BO, L), Rau, Sumatra.

M. maingayi Hook. *f.*, Fl. Brit. Ind. 2 (1876) 17. — Lectotype: *Maingay 475* (K), Malacca; syntype: *Maingay 472* (K), Malacca.
M. longipetiolata King, J. As. Soc. Beng. 65, ii (1896) 470. — Type: *King's Coll. 7266* (iso in BM, K), Perak.

The collection *SF 34699* (SING), made by Drian in Perak, cited under *M. quadrifida* as '*Drian 34699*' by Mukherji (Lloydia 12, 1949: 113), consists of three sheets. Of these specimens the petioles are up to 7 cm long; however, Mukherji recorded 2—4 cm in his description.

12. Mangifera similis Bl.

M. similis Bl., Mus. Bot. Lugd.-Bat. 1 (1850) 200; Backer & Bakh. *f.*, Fl. Java 2 (1965) 148. — Lectotype: *Korthals s.n.* (L, sheet no. *897.363—570*), fl., Martapura, Borneo.
M. torquenda Kosterm., Reinwardtia 7 (1965) 21, f. 2. — Type: *Kostermans 12533* (BO; iso in BM, K, L), W. Kutei, E. Borneo.

Among the authentic material of *M. similis*, there are two specimens with 'Java' printed on the labels: one specimen in flower marked with 'M' (=mihi) by Blume (sheet no. *897.363—567*, in L), and another sterile one marked with 'Bl' (sheet no. *897.363—568*, in L). These two specimens are very similar to the lectotype from Borneo cited above. They may have been collected from cultivated trees.

Besides, there is another specimen collected from a cultivated tree (origin from Bangka) in the Hort. Bogor. (sub no. VI.D.8). So far, I have not seen any other collections of this species from Java (cf. also Backer & Bakh. *f.*, l.c.), where it probably is not indigenous.

MELANOCHYLA

Melanochyla Hook. *f.*, Fl. Brit. Ind. 2 (1876) 38. — Lectotype: *M. auriculata* Hook. *f.*; syntypes: *M. angustifolia* Hook. *f.*, *M. maingayi* Hook. *f.*, *M. tomentosa* Hook. *f.*

Melanochyla is the only genus of the *Anacardiaceae* in Malesia with a distinct cup-like hypanthium which may have been formed by the fusion of calyx tube, receptacle, and other floral parts (cf. fig. 1c). Anatomical study of the hypanthium is still needed for elucidating its nature.

The petals are distinctly imbricate. However, one may find that they are only slightly overlapping in some mature flowers; this may have led Hooker *f.* to describe them as 'valvate' in the original generic description.

The ovary is mostly free. However, it is partly or completely immersed in the receptacle in some species, in which case it is seemingly semi-inferior or inferior. Fortunately, from the fruiting material available it could be ascertained that the ovary is really superior in this genus.

1. Melanochyla axillaris Ridl.

M. axillaris Ridl., Kew Bull. (1933) 198. — Lectotype: *Haviland 2211* (K; iso in BM, L, SING), Sarawak; syntypes: *Haviland 994* (K, SING), *2284* (BM, K, SING), Sarawak.

Fertile specimens of this species can easily be recognized by the short, crowded, axillary inflorescences or infructescences which are shorter than the stout (3—8 cm) petioles. There are so far only five collections known, all from Sarawak: four made by *Haviland* (*2764*, BM; and the three cited above) before 1894 and another by *Ilias Paie* (*S 13710*, L) in 1961.

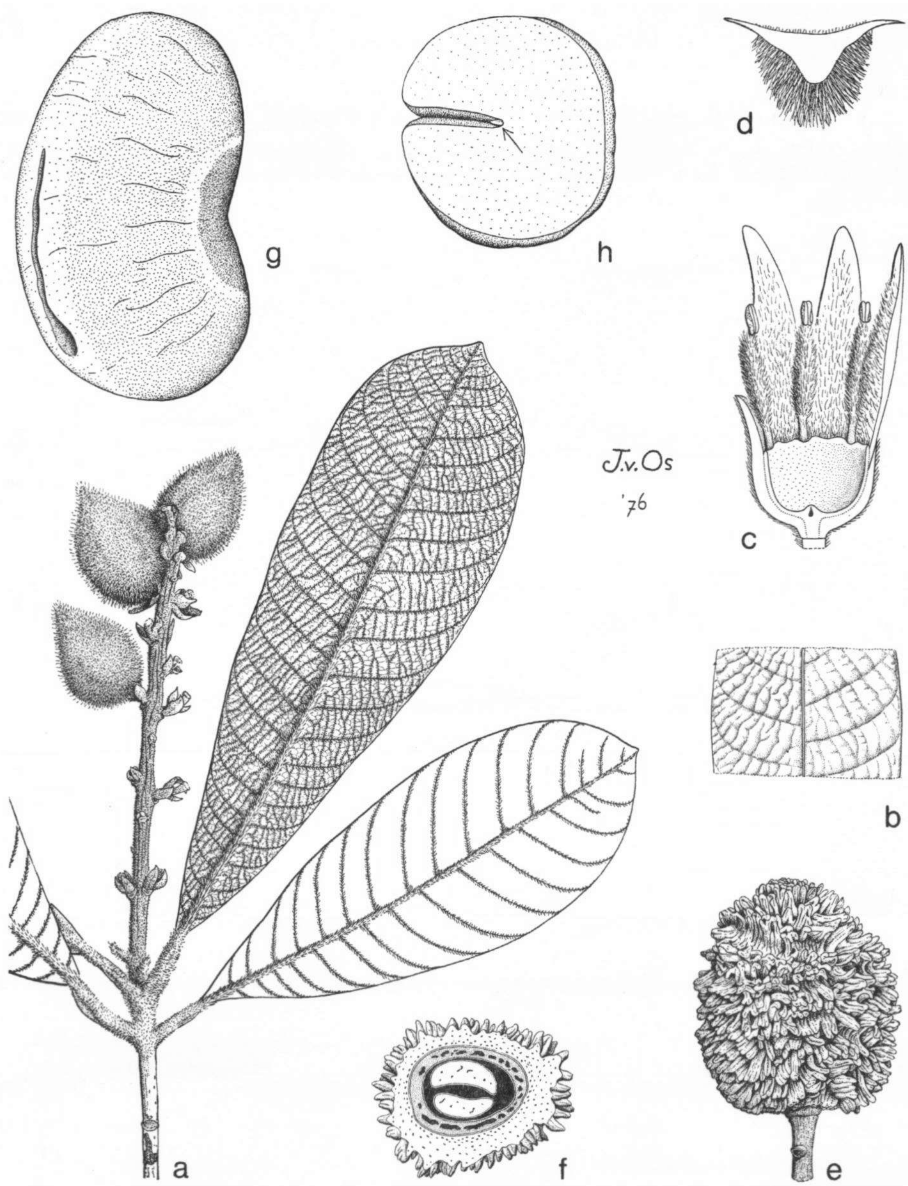


Fig. 1. *Melanochyla bullata* Ding Hou — a. Habit, × ½; b. upper leaf surface, showing the bulliform appearance, × ½. — *M. elmeri* Merr. — c. Longitudinal section of ♂ flower, × 7; d. transverse section of petals, showing the ridged and hairy inner surface × 14. — *M. fulvinervis* (Bl.) Ding Hou — e. fruit, × 1; f. ditto, transverse section, × 1. — *Gluta laxiflora* Ridl. — g. Embryo with incompletely free (or fused) cotyledons, obliquely lateral view, × ½; h. ditto, median transverse section, showing free and fused parts of cotyledons with an arrow pointing to the position of radicle and plume, × ½. (a & b. *Anderson et al. S 15436*; c & d. *Elmer 21333*; e & f. *SAN 17328*; g & h. *Ding Hou 319*).

2. Melanochyla borneënsis (Ridl.) Ding Hou, *comb. nov.* — **Plate II, 4.**

Nothopegia borneënsis Ridl., Kew Bull. (1933) 197. — T y p e: *Beccari PB 241* (K; iso in BO, L, S), Sarawak.

Specimens of this species can easily be identified by the lower surface of coriaceous leaves having distinct papillae in prominent, often horseshoe-shaped, groups separated by broad bands of veins and veinlets.

3. Melanochyla bullata Ding Hou, *spec. nov.* — **Fig. 1. a & b.**

Arbor 9—30 m alta et 19—83 cm diam., ramulis tomentosis, plerumque glabrescentibus. *Folia* oblanceolata vel obovato-oblonga, 13.5—42 × 5—9 cm, subtus tomentosa, basi cuneata vel attenuata, apice cuspidata; nervi (15—)33—38 paribus, supra impressi subtus prominentes; venae scalariformes, supra impressae, subtus elevatae; petiolus 2—2.7 cm longus. *Inflorescentiae* terminales, 15—17 cm longae, dense hirtae; bracteae ovatae ad anguste lanceolatae vel lineares, ad 8 mm longae, accrescentes, persistentes, dense hirtae. *Flores masculi* juvenes flavidi, sessiles, 3.7 mm longae. *Calyx* 2.5 mm longus, extus dense hirtus, lobis triangulatis, 1.5—2 mm longis. *Petala* ovata vel ovato-oblonga, 1.5—2 × 0.7 mm, extus puberula, intus villosa. *Discus* 2 mm altus. *Stamina* 1.3 mm longa; antherae 0.7 mm longae. *Pistillum* rudimentarium obscurum. *Flores feminei* adhuc ignoti. *Drupa* ovoidea, 3.5—4 × 2—4.5 cm, dense hirta.

T y p u s: Borneo. Sarawak: Lundu Dist., Bt Gebong, fr., *Anderson et al. S 15436* (L; iso in BO, SING).

Further specimens examined:

BORNEO. S a b a h. Tawau Dist.: Balung, fl., *Binson Sindin SAN 62909* (L); Tawau Hill For. Res., *Meijer & Binson SAN 62993* (L). — I n d o n. B o r n e o. Sebatic I., near coast, fr., *Kostermans 9152* (L).

E c o l o g y. In forests from lowland up to 500 m alt.

N o t e s. This species can be easily recognized by the bullate leaves with scalariform venation, persistent and accrescent bracts, and ovoid fruit covered with a thick layer of brown velvety hairs.

The specific epithet alludes to the characteristic bullate leaves.

4. Melanochyla caesia (Bl.) Ding Hou, *comb. nov.*

Semecarpus caesia Bl., Mus. Bot. Lugd.-Bat. 1 (1850) 189. — *Semecarpus heterophylla β. caesia* (Bl.) Engl. in DC., Mon. Phan. 4 (1883) 487. — L e c t o t y p e: *Blume s.n.* (L, sheet no. *897.363—1266*), veg., Tjampea, Java; s y n t y p e: *van Hasselt s.n.* (L, sheet no. *897.363—1264*), veg., Java.
M. maingayi Hook. *f.*, Fl. Brit. Ind. 2 (1876) 39. — T y p e: *Maingay 490* (K), fl., Malacca.
M. tomentosa var. *glabrescens* K. & V., Bijdr. 4 (1896) 133 & 135. — L e c t o t y p e: *Koorders 440* (BO; iso in L), fl., Java; s y n t y p e: *Koorders 12554* (BO), veg., Java.

The authentic material of *Semecarpus caesia* consists only of vegetative twigs and detached leaves. In sterile stage, it can hardly be identified to a genus with certainty.

Engler (l.c.) reduced *Semecarpus caesia* as a variety to *S. heterophylla*, while Koorders and Valeton (l.c.) placed it as a synonym of their new variety *Melanochyla tomentosa* var. *glabrescens*. Fortunately, with fertile material available, the type of *S. caesia* was found to belong to *Melanochyla*.

5. Melanochyla castaneifolia Ding Hou, *spec. nov.*

Arbor 9—24 m alta et 12.5—26 cm diam.; ramuli pallide flavidi-albi vel pallide cinerascentes, glabri. *Folia* elliptico-oblonga ad elliptico-lanceolata, vel ovato-oblonga, 6—14 × 2—5 cm, glabri, plerumque siccitatibus flavidi-virides, basi attenuata vel cuneata, apice breviter acuminata ad acuminata, interdum acuta, nervis 6—15 paribus, venis reticulatis, petiolo 1—2.5 cm longo. *Inflorescentiae* terminales vel axillares, 6—15 cm longae, breviter hirtae; pedicelli 0.5—1.5 mm longi. *Flores* flavi, 4 mm longi. *Calyx* 1.5—2 mm longus, extus leviter puberulus, lobis triangulatis, 1—1.2 mm longis. *Petala* elliptica oblonga, ovata, vel obovato-oblonga, 1.7—3 × 0.7—1.7 mm, extus puberula, intus villosa. *Stamina* 2.2 mm longa; filamentum ad apicem albidum; antherae 0.7 mm longae; staminodia parva, c. 1 mm longa. *Discus* non profunde infundibuliformis, 0.7—1 mm altus. Pistillum ampulliforme, 2 mm longum. *Ovarium* globosum, c. 1 mm diam., hirtum, stylo distincto; pistillum in floribus masculis rudimentarium, c. 0.7 mm longum. *Drupa* adhuc ignota.
Typus: Borneo. Sarawak: 4th Div., Bt Mentagai, fl., *Bunang ak Bubong S 23016* (L).

Further specimens examined:

BORNEO. Sarawak. 4th Div.: Bt Mentagai, fl., *Sibat ak Luang S 22843* (L), *23217* (L); Bintulu, fl., *Ilias Paie & Johnson S 15831* (BO, L). — Sabah. Lamag Dist.: Bt Pin Kinabatangan, fl., *Jawanting SAN 36472* (L); Sandakan Dist.: Sekong Kechil, fl., *James Ah Wing SAN 38965* (L).

Ecology. On ridges in lowland primary forests; up to 100 m alt.
Notes. This species can be easily recognized by the following vegetative characters: 1) branchlets light yellowish white or light greyish, glabrous, 2) leaves glabrous, usually yellowish green in dry state, and 3) papillae usually obscure on the lower leaf surface. Its closest relative is *M. angustifolia*.

6. Melanochyla densiflora King

M. densiflora King, J. As. Soc. Beng. 65, ii (1896) 503. — Syntypes: *King's Coll. 5615* (iso in BM, K, SING), *5626* (iso in BM, K), Perak.

King's authentic material of this species is supposed to be in the Herbarium of the Botanic Garden, Calcutta. The duplicates of it examined have rather young short inflorescences which look 'condensed' as indicated by the epithet.
The papillae on the lower leaf surface are often brown, compact, and obscure; sometimes they are whitish, distinct, and powder-like; this can be observed on different leaves of the same collection or sometimes even on the same leaf (cf. *SF 32175*, SING).

7. Melanochyla fulvinervia (Bl.) Ding Hou, *comb. nov.* — Fig. 1, e & f.

Semecarpus? fulvinervia Bl., Mus. Bot. Lugd.-Bat. 1 (1850) 189; Steenis, Blumea 11 (1961) 132. — Lectotype: *Korthals s.n.* (L, sheet no. *897.363—1228*), Mt Parawan, Borneo.
M. rugosa King, J. As. Soc. Beng. 65, ii (1896) 505. — Type: *Wray 1301* (iso in BM, K), Perak.

The authentic material of *Semecarpus? fulvinervis* is sterile and consists of five sheets. It was probably collected from a young tree. Van Steenis (l.c.) and Hildebrand found that it belongs to *Melanochyla*; they stated not having the intention to make a new combination because they had doubt whether it could ever be identified with certainty. Fortunately, while revising the genus *Melanochyla*, I found out its specific identity. Its leaves match with those of *M. rugosa* especially in the cordate base, villose midrib, and whitish papillae

aggregating in groups together with scattered reddish brown trichomes. These two species are conspecific and as the name *Semecarpus fulvinervis* is older, a new combination is needed.

8. Melanochyla minutiflora Ding Hou, *spec. nov.*

Arbor 9—13.5 m alta et 15—30 cm diam., ramulis brunneis. *Folia* elliptico-oblonga, 10.5—16.5 × 3.7—5 cm, subtus costa et nervis leviter puberulis, basi cuneata ad attenuata, apice cuspidata, interdum acuminata, nervis 11—15 paribus, venis reticulato-scalariformibus, petiolo 0.7—1.2 cm longo. *Inflorescentiae* terminales vel axillares, 5—6 cm longae, puberulae; bracteae triangulares, 0.5—1 mm longae. *Flores masculi* flavi, sessiles, 2—2.5 mm longi. *Calyx* 1.2—1.7 mm longus, extus puberulus, lobis triangulatis, c. 0.7 mm longis. *Petala* elliptico-oblonga vel oblanceolata, 1.7—1.5 × 0.5—0.7 mm, extus puberula, intus villosa. *Discus* breviter cupulatus, 0.7 mm altus. *Stamina* 1.3 mm longa; filamentum ad apicem albidum; antherae 0.3 mm longae. *Pistillum* in floribus masculis nullum. *Flores feminei* adhuc ignoti. *Drupa* subglobosa, 1.3 × 1.2 cm, dense breviter hirta.

T y p u s: Borneo. Sabah: Sandakan Dist., Lungmanis For. Res., fl., *Charington SAN 17810* (L).

Further specimens examined:

Borneo. S a b a h. Lamag Dist., Bt. Garam, Kinabatangan, fl., *Ampuria SAN 36562* (L). Tawau Dist., Sg. Salimpuporn, fr., *Bakar SAN 24997* (L).

E c o l o g y. Lowland primary forests; up to 100 m alt.

N o t e s. This species is characterized by the chartaceous not papillose leaves, small flowers (2—2.5 mm long), and small, short-hairy, subglobose fruits (*c.* 1.2 cm ⌀). The flowering specimens resemble those of *Semecarpus.*

9. Melanochyla semecarpoides Ding Hou, *spec. nov.*

Arbuscula 6 m alta et c. 8 cm diam., ramulis glabris albidis. *Folia* elliptico-oblonga vel elliptico-lanceolata, 16.5—25 × 6—10 cm, glabra, subtus distincte papillata, basi cuneata, apice acuminata, nervis 11—16 paribus, venis reticulatis, petiolo 1.7—2.5 cm longo. *Inflorescentiae* terminales, 18—21 cm longae, leviter puberulae. *Flores masculi* pallide virides, subsessiles, 4.7 mm longi. *Calyx* 4 mm longus, extus sparsim puberulus, lobis triangulatis, 2 mm longis. *Petala* triangulata, 2.3 × 2 mm, extus leviter puberula, intus villosa. *Stamina* 1.3 mm longa; antherae 0.5—0.7 mm longae, leviter apiculatae. *Discus* breviter cupulatus, c. 2 mm altus. *Pistillum* rudimentarium obscurum. *Flores feminei* et *drupa* adhuc ignoti.

T y p u s: Borneo. Sarawak: 4th Div., Ulu Mayeng, Kakus, fl., *Sibat ak Luang S 21799* (L).

E c o l o g y. In mixed dipterocarp forest, basalt hillside; *c.* 200 m alt.

N o t e s. This species is known only from one flowering (♂) collection. The specimen looks very much like a *Semecarpus* as alluded to by the specific epithet and was distributed under that generic name. It is closely allied to the Malayan *M. nitida*, but differs in the glabrous whitish branchlets, distinctly papillose lower leaf surface, and slightly apiculate anthers.

NOTHOPEGIA

Nothopegia castaneaefolia (Roth) Ding Hou, *comb. nov.*

Ficus castaneaefolia Roth, Nov. Pl. Sp. (1821) 389. — T y p e: *Benj. Heyne s.n.* (iso in L).

There is an isotype of *Ficus castaneaefolia* Roth, consisting of small twigs with three leaves and one young fruit, collected by Benj. Heyne from oriental India, with copied original Latin diagnosis, in the Rijksherbarium at Leiden. On the upper left corner of the label there is a numeral '1818' which represents the year of the collection made (cf. the preface of Roth's book); it is not a field number (cf. Blumea 12, 1963: 14) because this numeral has also been found on other collections of Heyne. The name was not accounted for in the Flora of British India.

Corner (Gard. Bull. Sing. 21, 1965: 97) studied this specimen and made detailed notes and drawings of the lower leaf epidermal cells (with plicate papillae) and the sectioned fruit (with 4 hypogynous short sepals and mucilage or oil(?) sacs in the fruit wall). He excluded this species from *Moraceae* and stated that 'according to van Steenis (in litt.), it is *Anacardiaceae*, such as *Melanorrhoea* or *Semecarpus*'.

Van Steenis (Blumea 12, 1963: 14) had examined this specimen together with Mr F. H. Hildebrand and Mr H. K. Airy Shaw respectively and concluded 'that it is in all probability an Anacardiaceous plant, possibly belonging to *Melanochyla* or *Melanorrhoea*'.

The papillose leaves and fruit full of 'mucilage' ducts in the wall resemble those of *Melanochyla*, a genus so far known only occurring in Malesia, and differ from those of *Gluta* (incl. *Melanorrhoea*). The papillose leaves and venation also look like those of *Semecarpus*, but the fruit differs from those of that genus by the absence of the characteristic hypocarp.

After having checked the genera of *Anacardiaceae* treated in the Flora of British India, the specimen in question fits the genus *Nothopegia*. Examination of Indian collections of this genus confirmed the identity. Among them was a fruiting specimen, *K. C. Kanodia 96408* (L), from Goa, India, distributed as *Nothopegia dalzellii* Gamble, which is very similar to the one of Heyne except that the papillae are invisible on the lower leaf surface, but in my opinion it undoubtedly belongs to the present species.

RHUS

In 1942, Barkley (Amer. Midl. Nat. 28: 472) published a new genus in a footnote as follows: '*Duckera* Barkley 1942 (*Duckera n. gen.* = (*Rhus*) Section *Melanocarpae* Engl. Bot. Jahrb. 1: 380, 1881. Named after Elizabeth Ducker Barkley)'. The Sect. *Melanocarpae* Engl. was based on *Melanococca* Bl. (cf. Engl. in DC., Mon. Phan. 4, 1883: 375). It appeared that the typification of this section escaped Barkley's attention. He did not adopt an earlier name, *Melanococca* Bl., available for his new genus. So the name of his new genus is nomenclaturally superfluous and illegitimate. Taxonomically, his new genus was already reduced to *Rhus* by Brizicky (J. Arn. Arb. 44, 1963: 62 & 63).

DUBIOUS SPECIES

Otonychium? retusum Miq., Fl. Ind. Bat. 1, 2 (1859) 572 (*Sapindaceae*). = probably *Rhus taitensis* Guillem. (1837).

This species was based on a Javanese specimen in flower (♂) and was placed at first in the *Sapindaceae*. Radlkofer (Sapindac. Holländ.-Ind. 1879: 14; Pfl. R. Heft 98, 1934: 1462) excluded it from that family and identified it as *Rhus*. My colleague Dr P. W. Leenhouts called my attention to Radlkofer's treatment of it. Both of us did not find the type at Utrecht or Leiden. According to some of the characters recorded in the original descrip-

tion (e.g. leaves imparipinnate, 3—5-jugate; panicles terminate; flower with a small annular glabrous disk), this plant could be *Anacardiaceous* and then it could be a member of *Rhus*, probably *R. taitensis*.

SEMECARPUS

1. Semecarpus borneensis Merr.

The type of this species was collected by *Agama* (no. *1061*) at Rosop, near Kudat, Sabah, in November, 1920. It may have been destroyed during the war in the fire of the Manila Herbarium. I have not seen any duplicate of it. Fortunately, there is a photograph of it in the Arnold Arboretum.

There is one specimen in the Singapore Herbarium (sub *Herb. Accession Register no. 018076*) consisting of one flowering (♂) branch and two detached leaves, which was received on 26 May, 1914, together with a letter from Mr J. F. Homsey, Ranau, near Kudat, for identification because 'the juice of this plant produces a severe inflammation'. It was annotated by Dr Furtado, in 1960, as *Semecarpus rufovelutinus* Ridl. Another specimen, collected by Meijer (*SAN 26481*, L), Mt Kinabalu, at 600 m alt., consists of three twigs (flowering, fruiting, and sterile, respectively), evidently from different plants. These two collections match very well with the type photograph and the original description of the present species.

2. Semecarpus bracteatus Lauterb. — Plate III, 6.

S. bracteatus Lauterb., Bot. Jahrb. 56 (1920) 372. — Type: *Moszkowski 260* (fragments in WRSL), N. New Guinea.

S. archboldianus Merr. & Perry, J. Arn. Arb. 22 (1941) 541. — Type: *Brass & Versteegh 12590* (A, *n.v.*; iso in BO, L), S. New Guinea.

The type of *S. bracteatus* is a female flowering specimen from northern New Guinea. Fragments of it, together with the field note copied by Lauterbach, were on loan from Wroclaw (WRSL), Poland.

S. archboldianus was based on a fruiting collection from southern New Guinea. Its leaves with characteristic papillae on the lower surface (pl. III, 6) are similar to those of *S. bracteatus*. I have examined additional fertile collections and concluded that these two species are evidently conspecific.

3. Semecarpus glauciphyllus Elmer

S. glauciphyllus Elmer, Leafl. Philip. Bot. 4 (1912) 1501; Merr., En. Philip. 2 (1923) 474. — Type: *Elmer 12276* (iso in BO, L), Sibuyan.

S. acuminatissima Merr., Philip. J. Sci. 7 (1912) Bot. 282; En. Philip. 2 (1923) 474. — Syntypes: *Ramos BS 13241* (K), Tayabas Prov.; *Ramos BS 5058* (US), Zambales Prov.

S. oblongifolius Quisumb., Philip. J. Sci. 76 (1944) 43, *nom. illeg.*, *non* Thwaites (1859). — Type: *Oro FB 30688* (fragments of holo in A), Tayabas Prov.

Merrill (1923) rightly reduced his own species *S. acuminatissima* to *S. glauciphyllus*.

The type of *S. oblongifolius* Quisumb., a fruiting specimen, was collected from Quinayañgan, Barrio Malbog, Tayabas Prov., Luzon. I examined only fragments of it (a leaf, two fruits, and a carbon rubbing print of a leaf). There are two other specimens which were also collected from Tayabas Prov.: *BS 19428* (US), ♀ fl.; *BS 28994* (US), young fr. They are similar to the types of *S. oblongifolius* and *S. glauciphyllus*. These three species are conspecific.

4. **Semecarpus macrophyllus** Merr.

S. macrophyllus Merr., Bull. For. Bur. Philip. 1 (1903) 33. — *Oncocarpus macrophylla* C. B. Rob., Philip. J. Sci. 6 (1911) Bot. 340. — Type: *Ahern 348* (not seen), Surigao.
S. surigaënsis Merr., Philip. J. Sci. 17 (1921) 272. — Type: *Ramos & Edaño BS 34772* (A, K, US), Surigao.

S. macrophyllus was based on a fruiting specimen which I have not seen. I examined the other fruiting specimen, *Ahern 529* (BO) (erroneously cited as 'no. 526', cf. Merr., En. Philip. 2, 1923: 476) from the type locality and also cited with the original description. Merrill (1903) described the calyx lobes as 'persistent, lanceolate, acute, 5 to 6 mm long, tomentose'. The 'calyx lobes' are actually petals.

The type of *S. surigaënsis* was also collected from Surigao. It is a well-preserved ♂ flowering specimen and belongs to the present species.

5. **Semecarpus nidificans** (Lauterb.) Ding Hou, *comb. nov.*

Nothopegiopsis nidificans Lauterb., Bot. Jahrb. 56 (1920) 363, f. 4. — Type: *Ledermann 10640* (fragments of holo in WRSL), NE. New Guinea.

Fragments of the type and a duplicate of *Ledermann 6818*, both in flower, together with the original drawings made by Lauterbach, were on loan from Wroclaw (WRSL). The present species is a distinct one and can be easily recognized by the linear or oblanceolate, aggregate, leaves which are characteristically subverticillately arranged on the branches at intervals like a 'nest' as denoted by the epithet.

In addition to the specimens mentioned above, I have also examined the following collections, all from New Guinea: *Docters van Leeuwen 9310* (BO), fl., *9334* (BO, L), veg.; *Lam 749* (BO), fl.; *Sayers NGF 13262* (L), young fl.; *Schodde (and Craven) 4355* (L), fl., *4626* (L; *p.p.*, mixed with *S. magnificus*), fl.

6. **Semecarpus papuanus** Lauterb.

S. papuanus Lauterb., Nova Guinea 8 (1912) 829; Bot. Jahrb. 56 (1920) 368. — Type: *Von Römer 10* (L, holo; print of leaf and fragments of infl. in WRSL), New Guinea.

According to Lauterbach (1912), the type of the present species consists of one leaf and loose flowering panicles. Judging from the carbon rubbing print of the leaf of the type together with the fragments of inflorescences on loan from the herbarium at Wroclaw (WRSL), Poland, it is evident that the specimen in the Rijksherbarium, Leiden, is the holotype.

In 1920 Lauterbach (l.c.) amended the description and cited, besides the type, the following collections: *Ledermann 7395* (WRSL), *7448* (K), and *12333* (WRSL), and *Moszkowski 254* (WRSL). The big leaf which he described as '1 m long, 24 cm wide' belongs to *Moszkowski 254*.

7. **Semecarpus paucinervius** Merr.

S. paucinervius Merr., Philip. J. Sci. 7 (1912) Bot. 286; En. Philip. 2 (1923) 475. — Type: *Foxworthy BS 750* (iso in BO), Palawan.
S. obtusata Elmer, Leafl. Philip. Bot. 5 (1913) 1752. — Type: *Elmer 13003* (iso in BM, BO, K, L), Palawan.

The type of *S. paucinervius*, a ♂ specimen, was erroneously cited under the original description as 'Bur. Sci. 570'; this error was rightly corr[illegible] as 'B.S. 750' by Merrill

himself (1923). The type of *S. obtusata* is a ♀ specimen. Both collections were made in similar habitats in the central part of Palawan. Elmer (l.c.) stated that the leaves of his new species are similar to those of Merrill's but that the flowers of these two species are not the same. In fact, Elmer compared the ♀ flowers of his specimen with the ♂ ones of Merrill's species.

8. Semecarpus stenophyllus Merr.

S. stenophyllus Merr., Philip. J. Sci. 30 (1926) 407. — Type: *McGregor BS 43886* (UC; iso in NY), Samar.

Merrill (l.c.) stated that this species is 'very strongly characterized by its numerous, elongated, very narrow leaves'. The type is a fruiting twig bearing young fruits and one flower bud. It did not have any ecological note on the label, but Merrill assumed 'that this stenophyllous *Semecarpus*, ... „grows along the margins of small streams in places subject to sudden and brief overflows".

There are two additional fruiting specimens, *Clemens 16755* (NY) and *Gutierrez PNH 78317* (A), which were obtained from small trees, at San Mariano, Isabela Prov., Luzon, both found in a thicket on a river-bank.

DUBIOUS SPECIES

Semecarpus obovatus (Elm.) Steen.

S. obovatus (Elm.) Steen., Philip. J. Sci. 91 (1962) 508. — *Dichapetalum obovatum* Elm., Leafl. Philip. Bot. 2 (1908) 483. — *Oncocarpus obovatus* Merr., Philip. J. Sci. 14 (1919) 413; En. Philip. 2 (1923) 476. — Type: *Elmer 7931* (not seen), Philippines, Luzon.

Elmer (l.c.) published *Dichapetalum obovatum (Dichapetalaceae)* based on his own collection, in fruit, from Luzon: Tayabas Prov., Lucban, Mt Banahao. He described its single young fruit: 'sessile, its base substipitate, ... with an apiculate style, 2-celled, 1 seed in each cell, stigma several sulcate or with several very short lobes...'.

Merrill (1919) realized that this plant could not be a member of that family. When he received similar material in flower (♂) (*Quisumbing 1346*, not seen) collected from near the type locality, he concluded that Elmer's species belonged to the genus *Oncocarpus* (= *Semecarpus*) (*Anacardiaceae*) and made a new combination: *O. obovatus*. According to the characters of the male flowers described by him, especially 'the rudimentary ovary densely villous', the plant concerned has probably been correctly placed in *Oncocarpus* (= *Semecarpus*). He said that the single fruit on the type is '1-celled and 1-seeded, although it is described as 2-celled with one seed in each cell' and 'the pedicel is only slightly thickened in fruit'.

Because *Oncocarpus* Asa Gray (Bot. U. S. Expl. Exped. 1, 1854: 364) and *Semecarpus* L. *f.* (Suppl. 1781: 285) are congeneric, Van Steenis (l.c.) made the necessary transfer.

The type and *Quisumbing 1346* or their duplicates could not be found in the following herbaria: A, BO, BM, K, L, NY, S, SING, U, UC, US. The authentic specimens of these two collections were apparently destroyed with the Manila Herbarium. Because Elmer and Merrill did not mention the fruit characteristics of *Semecarpus*, i.e. hypocarp and 3 styles, which can be easily observed even on young fruit, this species cannot be placed with certainty from the description only.

EXCLUDED SPECIES

Semecarpus engleriana Lauterb., in K. Sch. & Laut. Nachtr. (1905) 303; Bot. Jahrb. 56 (1920) 370. = cf. *Rhysotoechia* Radlk. (*Sapindaceae*).

This species was based on a specimen collected by *Schlechter* (no. *14532*) from Torricelli Mts, NE. New Guinea, alt. 600 m, April 1902. I have a carbon rubbing print, the original drawing and several detached ♂ flowers of the type, and fragments of a leaf and a few ♂ flowers of *Ledermann 8847* (from Sepik), on loan from WRSL. At first glance, the leaves of the print resemble those of *Semecarpus*. However, the flowering characters, e.g. 8 stamens together with petals and stamens pilose at the base, are quite different from those of *Semecarpus*. The number of stamens was not mentioned in the original description, but there are only five stamens shown on the original drawing.

Based on the macromorphological and palynological characters my colleagues Dr P. W. Leenhouts and Mr J. Muller identified the plant as *Sapindaceous*; it may be a member of the genus *Rhysotoechia*.

SPONDIAS

S. philippinensis (Elmer) Airy Shaw & Forman

In field notes this species was recorded as a liana up to 30 m high (e.g. *Kostermans 10502*, BO, L), a shrub up to 2½ m high (e.g. *Anthony A771*, SING), an epiphytic shrub (e.g. *S 22913*, K, L), a small tree up to 12 m high (e.g. *S 22093*, L), and a (big) tree up to 45 m high (e.g. *SAN A4834*, SING). A similar wide variation in habit occurs also in some species belonging to other families (cf. Airy Shaw & Forman, Kew Bull. 21, 1967: 15).

Specimens of this species were described or identified under various genera or species. The flowering and fruiting specimens from New Guinea were even described respectively under two different genera in the same publication by Lauterbach (Bot. Jahrb. 56, 1920: 356 & 360, f. 2): flowering specimens as a new monotypic genus, *Skoliostigma* Lauterb., and a fruiting collection as a new species, ?*Euroschinus ledermannii* Lauterb. (Type: *Ledermann 7606*, fragments of it seen from WRSL).

The difficulty to determine the collections of this species may be partly due to the wide and sporadical distribution, great variation of habit, and incomplete material.

SWINTONIA

1. Swintonia minutalata Ding Hou, *spec. nov.*

S. spicifera auct. non Hook. *f.*: Smythies, Common Pl. Sarawak (1965) 13.

Arbor usque 25 m alta et 50 cm diam. *Folia* elliptico-lanceolata, 11.5—22.5 × 3—6.5 cm, basi cuneata, apice acuminata, nervis 12—20 paribus; petiolus 3.5—6.5 cm longus, a basi ad 2/3 teres. *Inflorescentiae* 22—26 cm longae, puberulae, bracteis ovatis, 0.5—0.7 mm longis; pedicelli c. 1 mm longi. *Calyx* profunde 5-lobatus, extus sparsim puberulus, lobis suborbicularibus, 0.5—1 mm diam. *Petala* late elliptica vel elliptica, 1.5—2.5 × 1—1.5 mm, utrinque puberula, glabrescentia, basi unguiculata, apice obtusa. *Discus* distincte 5-lobatus. *Stamina* 0.7—1.2 mm longa; antherae oblongae c. 0.3 mm longae. *Ovarium* globosum, 1 mm diam., interdum abortivum, stylo 0.5 mm longo, stigmate capitellato. *Drupa* globosa, c. 1.5 cm diam.; petala accrescentes, parva, elliptica vel ovato-oblonga, 0.7—1.2 × 0.3—0.7 cm.

T y p u s: Borneo. Sarawak: Arboretum, Semengoh, fl. & young fr., *Rosli S 14966* (tree no. 3427) (L; iso in K).

Further specimens examined:

BORNEO. S a r a w a k. Arboretum, Semengoh: fr., *Muas S 0165* (SING); fr., *Rosli S 15180* (tree no. 3427) (K, L); fr., *Jugah S 15783* (tree no. 902) (K, L); fr., *Haji Bujang S 32541* (tree no. 902) (L); veg., *Sinclair & Kadim bin Tassim 10180* (SING). Bako Nat. Park. fl., *Anderson S 20927* (K). — I n d o n. B o r n e o: Nunukan I., fr., *Kostermans 8700* (L).

E c o l o g y. Primary lowland forests; up to *c.* 100 m alt.

N o t e s. The cited specimens are homogeneous and most of them were collected from the numbered trees in the Semengoh Arboretum, Sarawak. Two specimens, *S 14966* and *S 15180*, with flowers and fruits respectively, were fortunately obtained from the same tree.

This species is related to the Malayan *S. robinsonii* in having fruits with rather small accrescent petals. It differs from that species by the leaves distinctly papillose on the lower surface, the calyx divided almost to the base, and the disk lobes confluent with the bases of filaments.

2. Swintonia schwenkii (T. & B.) T. & B. *ex* Hook. *f.*

In 1855 H. Schwenk sent a number of young plants (mainly *Dipterocarpaceae*), collected from Morsala I., opposite the Bay of Tapanuli, W. Sumatra, to the Botanic Gardens at Buitenzorg. One of the plants flowered in 1860 and was described by Teysmann and Binnendijk (in Miq., J. Bot. Néerl. 1, 1861: 368) as a monotypic genus, *Anauxanopetalum* T. & B. (*Anacardiaceae*); the species was named as *A. schwenkii* T. & B., dedicated to the memory of its collector.

Teysmann and Binnendijk apparently found out later that the species cultivated in their Gardens actually belonged to *Swintonia*. In 1866, in their 'Cat. Hort. Bot.', under *Anacardiaceae* (pp. 230—231), the name *Anauxanopetalum schwenkii* was omitted, but instead there is an entry for it as follows: '*Swintonia schwenckii* T. & B. — 5 [=tree over 25 feet high] — Sumatra [= land of origin]'.

It is evident that *Anauxanopetalum schwenkii* T. & B. and *Swintonia schwenkii* T. & B. ('*schwenckii*') were based on material from the same plant. Since these two names have the same epithet, the latter can be treated as a combination which was validated by Hooker *f.* (Fl. Brit. Ind. 2, 1876: 26).

Leaves of seedlings, germinated at Leiden from seeds received from the Malay Peninsula (*Kochummen s.n.* & *FRI 2559*), have glabrous domatia like those observed on the specimens collected from trees.

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New names are in **bold type**, synonyms in *italics*, accepted and other names in plain type. Page numbers in bold type refer to figures.